American Foundryman

THE FOUNDRYMEN'S *Own* MAGAZINE

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CAN YOUR BUSINESS CONTINUE TO PROSPER WITHOUT NEW BLOOD?

Hiring and training the best young men for future foundrymen are the most important steps in any youth encouragement program for the foundry industry.

The A.F.A. Educational Division has suggested a simple, direct plan to foundries for the recruiting of youth. Already sent to foundry management, the plan explains how to bring new blood into the foundry industry. The procedure described has been used successfully by other industries and it is recommended to foundries because of its simplicity and effectiveness.

The new-blood plan, briefly, is as follows:

Contact the school most likely to supply the type of men needed by the company. Through the school principal or engineering college dean, meet the proper faculty members and explain your problems and plans. Invite faculty members to the foundry, explain its operations, and point out the number and the types of jobs open to young men.

Student plant visitations arranged through the faculty are the foundry's opportunity to show itself off to young men. These tours require the best men as guides and should follow a carefully planned sequence of operations so that the student understands what goes on in a foundry.

Personal interviews with the young men can best be arranged through the faculty. The teaching staff will be glad to give valuable advice regarding what other companies are offering in the way of salary and other inducements, and regarding the features of a company or a job most likely to appeal to young men.

Foundry executives should remember that other companies are seeking the same boys and that prompt and positive action should be taken.

Good young men are an industry's greatest asset. A well organized training program for young men, therefore, is a worthwhile investment for the company, not only in increased efficiency, but also in loyalty to the company.

The Educational Division is organized to help foundries, directly and through the A.F.A. chapters, employ and train young men. However, the most important part of the new-blood plan recently proposed is the direct contact between the foundry and the young men. For this, there is no substitute. Since the end of the school year is only a few months off, foundry management should take prompt action to contact the proper school and to secure new blood for summer jobs and permanent foundry jobs.

Frederick G. Sefing.

Frederick G. Sefing, *Chairman*
A.F.A. Education Division

Frederick G. Sefing, Chairman of the A.F.A. Educational Division, has long been a leader in foundry educational activities. For a number of years he headed the Committee on Cooperation with Engineering Schools which was incorporated in the Educational Division formed late in 1946. A trustee for A.F.A. in the Foundry Educational Foundation, he has held several industrial positions and taught at Michigan State College.

CASTINGS TODAY IS FOUNDRY CONGRESS THEME

FINAL STAGES OF PREPARATION for A.F.A.'s Convention and Exhibit of 1948, in Philadelphia, May 3-7, were reached early this month. Philadelphia Convention committees, Division and General Interest groups and the Association's National Office have begun to finalize the general program for the five days when Philadelphia will be host to the foundry world.

One of the largest shows in the 52-year history of the Association is already virtually "under roof"; most of the program technical papers, keyed to the theme of *castings today* and incorporating a wealth of data on new developments in foundry technology, are in print.

Preprint request forms have been mailed to all members, and distribution of preprints will begin April 1st. Assignment of housing accommodations began in February; applications were mailed in January. All hotel rooms will be assigned by the A.F.A. Housing Bureau, to which requests should be directed, in care of the Philadelphia Convention and Visitors' Bureau, 17th and Samson Sts., Philadelphia.

Technical Programs Completed

With their technical programs completed, Divisions have turned to arrangements for their Round Table sessions and for the business meetings they will hold during the five-day Foundry Congress.

The Round Table Luncheon of the Brass and Bronze Division, Monday, May 3, will have as discussion leader H. L. Smith of Federated Metals Division, American Smelting & Refining Co., Pittsburgh. *Melting of Brass and Bronze* will be the topic, a continuation of that discussed at the 1947 luncheon in Detroit.

Topic of the Aluminum and Magnesium Division Round Table, Tuesday, is *Permanent Mold Casting of Aluminum and Magnesium Alloys.* Walter J. Klayer of Aluminum Industries, Inc., Cincinnati, will serve as chairman; Marvin E. Gantz of American Magnesium Corp., Cleveland, as co-chairman.

Martin Rintz of Continental Foundry & Machine Co., East Chicago, Ind., will be a discussion leader at the Pattern Round Table, Wednesday.

Presentation and discussion of a Naval Research Laboratory color film, showing the flow of metal into a mold, will be featured at the noon Round Table of the Steel Division, Thursday.

Program and Papers Committee chairmen of the various Divisions have announced the following technical papers and authors, not previously reported:

Aluminum and Magnesium Division – Manley E. Brooks, Dow Chemical Co., Bay City, Mich., Vice-Chairman—*The Ste[illegible]ging of a Magnesium-Base Casting Alloy,* G. Sachs [illegible]nd E. J. Vargo of Case Institute of Technology, Cleveland; *The Effect of Gating Design on Metal Flow in the Casting of Magnesium Alloys,* H. E. Elliott, Dow Chemical Co., Bay City; *Can Castings be Engineered?,* F. G. Tatnall, Baldwin Locomotive Works, Eddystone, Pa.

Development of a Permanent Mold for Aluminum and Magnesium Test Bars, L. J. Ebert, G. Sachs and R. E. Spears of Case Institute of Technology; *Effect of Titanium on Grain Size and Mechanical Properties of No. 185 Aluminum Alloy,* W. E. Sicha and R. C. Boehm, Aluminum Co. of America, Cleveland; *A Study of Factors Affecting the Pouring Rates of Castings,* H. E. Elliott of Dow Chemical Co. and J. G. Mezoff of Saginaw Bay Industries, Bay City, Mich.

Light metals foundrymen will also be especially interested in the Charles Edgar Hoyt Annual Lecture of this year, *The Control of Grain Size in Magnesium Castings,* by Charles E. Nelson, technical director of the magnesium division of Dow Chemical Co., Midland, Mich., and in *Test Procedures for Quality Control of Aluminum and Magnesium Castings,* by E. V. Blackmun, chief works metallurgist of Aluminum Co. of America, one of the special series sponsored this year by the Annual Lecture Committee.

Included on the Brass and Bronze program, according to Division Vice-Chairman G. P. Halliwell of H. Kramer & Co., Chicago, are the exchange paper of the Institute of Australian Foundrymen, *The Technology of Copper-Lead Alloys* by R. W. K. Honeycombe, Melbourne; *Effect of Foundry Practice on Properties of Some Binary Copper-Silicon Alloys,* A. I. Krynitsky, W. P. Saunders and R. Sterm of the National Bureau of Standards, Washington, D.C., and *A New Permeable Metal Casting Plaster,* E. S. Johnson and K. A. Miericke, U.S. Gypsum Co., Chicago.

Resume Annual Lecture Series

William Romanoff, vice-president of H. Kramer & Co., will deliver a paper on *Test Procedures for Quality Control of Brass, Bronze and Nickel Alloy Sand Castings* in the Annual Lecture series, and many members of the Brass and Bronze Division will undoubtedly plan to attend this session.

Gray Iron Division program, as reported by Vice-Chairman V. A. Crosby, Climax Molybdenum Co., Detroit, includes a symposium on heat treatment, comprised of four papers: *Fundamentals of Heat Treating Gray Cast Iron,* by Alfred Boyles of U.S. Pipe & Foundry Co., Burlington, N. J.; *Hardening of Gray Iron by Air Quenching,* R. A. Flinn, American Brake Shoe Co.,

Mahwah, N.J.; *Stress Relief of Gray Iron Castings,* J. H. Schaum of the Naval Research Laboratory, Washington, D.C.; and *Martempering Gray Iron Cylinder Sleeves,* G. Lahr of Detroit Diesel Engineering Division, General Motors Corp., Detroit.

Also scheduled by the division are *A Laboratory Investigation of Some Automotive Cast Irons,* by A. B. Shuck of the American Hammered Piston Ring Division of Koppers Co., Baltimore; *A Suggested Method for the Determination of Coke Reactivity to CO_2 at Combustion Temperatures,* H. E. Flanders, University of Utah, Salt Lake City; the exchange paper of the Institute of British Foundrymen—a Convention feature since 1921—*Contraction and Distortion in Ferrous Castings,* by E. Longden, works manager of P. R. Jackson & Co., Manchester, England; and *Production of Nodular Graphite in Gray Iron,* H. Morrogh, British Cast Iron Research Association.

The division will be heavily represented at the session on *Test Procedures for Quality Control of Gray Iron Castings* of the Annual Lecture series. Fred J. Walls, metallurgist in charge of the Detroit office of International Nickel Co., past president of A.F.A., is the lecturer.

W. B. McFerrin, Electro Metallurgical Co., Detroit, Malleable Division Vice-Chairman, announces the scheduling of *Effect of Common Alloying Elements on Tensile Properties of Malleable Iron,* W. K. Bock and H. A. Schwartz, National Malleable & Steel Castings Co., Cleveland, and *Pearlitic Malleable Irons, Plain and Alloyed,* Professor Richard Schneidewind, University of Michigan, Ann Arbor.

Electro-Chemical Cleaning of Steel Castings

For the Steel Division, Vice-Chairman Charles Locke, Armour Research Foundation, Chicago, has announced, E. L. LaGrelius and J. D. Wozny of American Steel Foundries, East Chicago, will present *Techniques for Quality Welding of Plain Carbon Steel Castings;* S. W. Brinson and J. A. Duma of Norfolk Naval Shipyard, Portsmouth, Va., *Observations on Knock-Off Risers as Applied to Steel Castings;* J. A. Wettergreen, General Electric Co., Schenectady, N.Y., *Electro-Chemical Cleaning of Large Steel Castings—An Experiment.*

Quality control papers of the Lecture series will be presented by M. O. Booth, manager of the Saginaw (Mich.) Malleable Iron Plant, Central Foundry Division, General Motors Corp., on malleable castings, and John Juppenlatz, chief metallurgist of Lebanon (Pa.) Steel Foundry, on steel castings.

Professor P. E. Kyle of Cornell University, Ithaca, N.Y., reports that the Sand Division, of which he is Vice-Chairman, will present the report of its Committee on Physical Properties of Iron Foundry Molding Materials at Elevated Temperatures, *Causes of Rat-Tail Casting Defects,* at one session. The committee will have available for the inspection of delegates the display of test panels of castings exhibiting rat-tail defects, prepared during its investigations. Another session will be devoted to *Surface Pressure of Molding Sands and Core Sands,* by H. W. Dietert, F. S. Brewster and H. H. Fairfield, all of Harry W. Dietert Co., Detroit.

A. W. Gregg, Whiting Corp., Harvey, Ill., Vice-Chairman of the Educational Division, has announced that G. K. Dreher, executive director of the Foundry Educational Foundation, Cleveland, will speak on *Engineering Education for the Castings Industry* at the Monday morning educational session. As previously reported, that session will also feature a question-and-answer program on problems relating to the recruiting and training of foundry personnel, with a six-man panel of speakers handling questions submitted in advance or raised during the discussion.

Foundry Cost Committee members will serve as consultants to the industry on cost accounting methods, distribution of costs, and application of cost data. The group, headed by Ralph L. Lee, comptroller of Grede Foundries, Inc., Milwaukee, has solicited questions on specific cost problems; those of the most general interest will be analyzed and discussed at the session on Thursday afternoon—and at a second meeting, if necessary, to deal fully with them all.

Repeat Refractories Information Panel

Richard H. Stone, Vesuvius Crucible Co., Swissvale, Pa., Chairman of the A.F.A. Refractories Committee, reports that an "information please" program will be offered at one of the group's two meetings—Wednesday afternoon and evening. At the other, S. M. Swain of North American Refractories Co., Cleveland, will discuss *Testing Refractories for the Foundry.*

A question-and-answer panel is planned for one of the two sessions—Thursday morning or afternoon—of A.F.A.'s Job Evaluation and Time Study Committee, according to Chairman Robert J. Fisher, Falk Corp., Milwaukee. *Grinding Standards Help Eliminate Cleaning Room Bottlenecks,* is the topic for the second meeting; Dean Van Order of Burnside Steel Foundry Co., Chicago, is the speaker.

Continuing trend toward foundry mechanization and modernization focuses on the timely subject of the Plant and Plant Equipment Committee session—innovations, with particular reference to smaller plants. Lester B. Knight of Lester B. Knight & Associates, Chicago, is the speaker on *Modernization of the Small Foundry.* James Thomson, Continental Foundry & Machine Co., East Chicago, Ind., is Committee Chairman.

Another phase of castings technology currently attracting a great deal of attention will be the subject of a comprehensive committee report at the meeting of the Heat Transfer Committee, Tuesday afternoon. Dr. Harry A. Schwartz, National Malleable & Steel Castings Co., Cleveland, Chairman, will introduce the review of committee investigations. Part 1 is *Thermal Conductivity of a Sand Mixture,* prepared by C. F. Lucks, O. L. Linebrink and Kay L. Johnson of Battelle Memorial Institute, Columbus, Ohio; Parts 2, 3 and 4, by Dr. Victor Pashkis, Columbia University, New York, cover studies on solidification of aluminum, white iron, and steel spheres.

Schedule Sessions for Convenience

Again this year, sessions of the Congress have been scheduled to facilitate attendance, in the minimum number of days.

Four Divisions—Aluminum and Magnesium, Brass and Bronze, Educational, Malleable—have centered their activities on Monday and Tuesday, May 3 and 4; the Pattern Division, Tuesday and Wednesday; Sand Division, Wednesday and Thursday; Gray Iron and Steel, Thursday and Friday.

Sand and gray iron shop course sessions will be held Monday through Thursday at 8:00 pm. The evening

hour has been selected, as in the past, for the convenience of local technologists and production men, who are expected to be present in large numbers for the practical, informal, off-the-record meetings.

As the Association convenes for the sixth time in Philadelphia, its birthplace, the great Show and Congress portray not only the advances of the castings field during the last half century, but also the growth of the A.F.A. itself. To the city where 345 delegates laid the foundation for an industry-wide foundry technical society in 1896, that society returns this year as the largest such organization in the world and with membership well over the 10,000 mark.

At the Chapter Officers and Directors Dinner, four new student groups will be represented; the re-organized chapter of the University of Minnesota and those of Ohio State University, Missouri School of Mines and Metallurgy, and Massachusetts Institute of Technology. Other chapters admitted since the Detroit Convention of last year include British Columbia, Central Michigan, Eastern New York—and probably by Convention time, Chattanooga.

Three Dominion chapters will be represented at the annual gathering of Canadian foundrymen, this year a dinner rather than the customary luncheon, with the British Columbia group joining the Eastern Canada and Newfoundland and the Ontario units.

Election of A.F.A. Officers and Directors will, of course, be a highlight of the Business Meeting, as will the second Annual Charles Edgar Hoyt Lecture. First place winners in the four divisions of the 24th Annual Apprentice Contest—which includes seven chapter-area and more than 20 plant competitions this year—will receive their awards from A.F.A. President Max Kuniansky, Lynchburg Foundry Co., at the meeting.

Other Major Foundry Organizations Plan A.F.A. Convention Activities

A number of the major foundry associations are planning active participation in the Philadelphia Convention, May 3-7, and several will use exhibit space provided by A.F.A. Among these groups are the Gray Iron Founders' Society, the Non-Ferrous Founders' Society, the Foundry Equipment Manufacturers' Association, and the Foundry Educational Foundation. These organizations will maintain headquarters booths in the Exhibit halls throughout the Convention, for the convenience of their respective memberships.

The Foundry Educational Foundation will hold its annual meeting during the Convention on Wednesday afternoon, May 5. All member-contributor organizations, as well as the Foundation Trustees, have been invited to attend and to learn what the Foundation is doing to stimulate greater cooperation between the foundry industry and educational institutions.

The Foundry Equipment Manufacturers' Association again is planning to hold meetings of its various product groups on May 4, 5 and 6, and a reception of the Board of Directors on Friday preceding the Annual A.F.A. Banquet. The Non-Ferrous Founders' Society will hold a board of directors meeting on Sunday, May 2, prior to the official opening of the Convention and Exhibit. A meeting of the board of directors of the Gray Iron Founders' Society has been planned for Wednesday morning, May 5.

A.F.A. and FEMA Act To Reduce Lavish Convention Entertainment

The Boards of Directors of both the A.F.A. and the Foundry Equipment Manufacturers' Association recently passed resolutions intended to minimize excessive entertainment at A.F.A. Conventions, in recognition of the serious purposes of these events.

At a meeting of the 1948 Committee last September, a unanimous motion requested A.F.A. to seek the cooperation of exhibitors in "abating excessive and unwarranted entertainment." As a result, the Executive Committee of the A.F.A. Board communicated with FEMA President O.A. Pfaff requesting cooperation of that large exhibiting group, and at the annual meeting of the Foundry Equipment Manufacturers' Association the following resolution was passed:

RESOLUTION

WHEREAS, There has developed over the past years conditions which have tended to increase entertainment on the occasion of meetings of foundrymen, particularly the annual conventions where those selling the foundry trade also attend, and

WHEREAS, The practice gives every promise, unless drastically checked, of not only continuing but increasing, and

WHEREAS, The excessive, lavish and wholesale entertainment, incident to conventions and exhibits of the American Foundrymen's Association, at which the members of the Foundry Equipment Manufacturers' Association are important exhibitors, and

WHEREAS, The abuses of the type outlined are resulting in conditions inimicable to the welfare of the foundry industry and the foundry equipment industry, and

WHEREAS, The American Foundrymen's Association has great concern with this question and has, through its President, addressed a communication to the Foundry Equipment Manufacturers' Association on this subject.

THEREFORE, BE IT RESOLVED at the January 22, 1948 meeting of the Board of Directors of the Foundry Equipment Manufacturers' Association that each and every member of this association be advised that the FEMA Board of Directors is convinced that the practice of promiscuous and wholesale entertainment of customers and others at the conventions and exhibits of the American Foundrymen's Association should be discountenanced, and

THEREFORE, BE IT FURTHER RESOLVED, that the members of the Foundry Equipment Manufacturers' Association be asked to pledge themselves to cooperate with the American Foundrymen's Association in the control and discontinuance of miscellaneous and unwarranted entertainment, which constitutes an unnecessary expense, a harmful practice and is contrary to good business ethics.

A.F.A. Policy Regarding Public Space

In keeping with the above resolution, the A.F.A. Board of Directors has approved the assignment of public space for entertainment purposes during the 1948 Convention only between the hours of 5:00 and 7:00 pm. Few such requests have been received, indicating fine cooperation on the part of exhibitors as a group. It is recognized that social relaxation plays a definite part in any Convention gathering, but that the "open house" type of entertainment may be unwarranted at an industrial convention, in justice to the authors, chairmen, speakers and others who devote great time and effort to making an A.F.A. Convention of maximum value to an entire industry.

FOUNDRY SAFETY AND HYGIENE

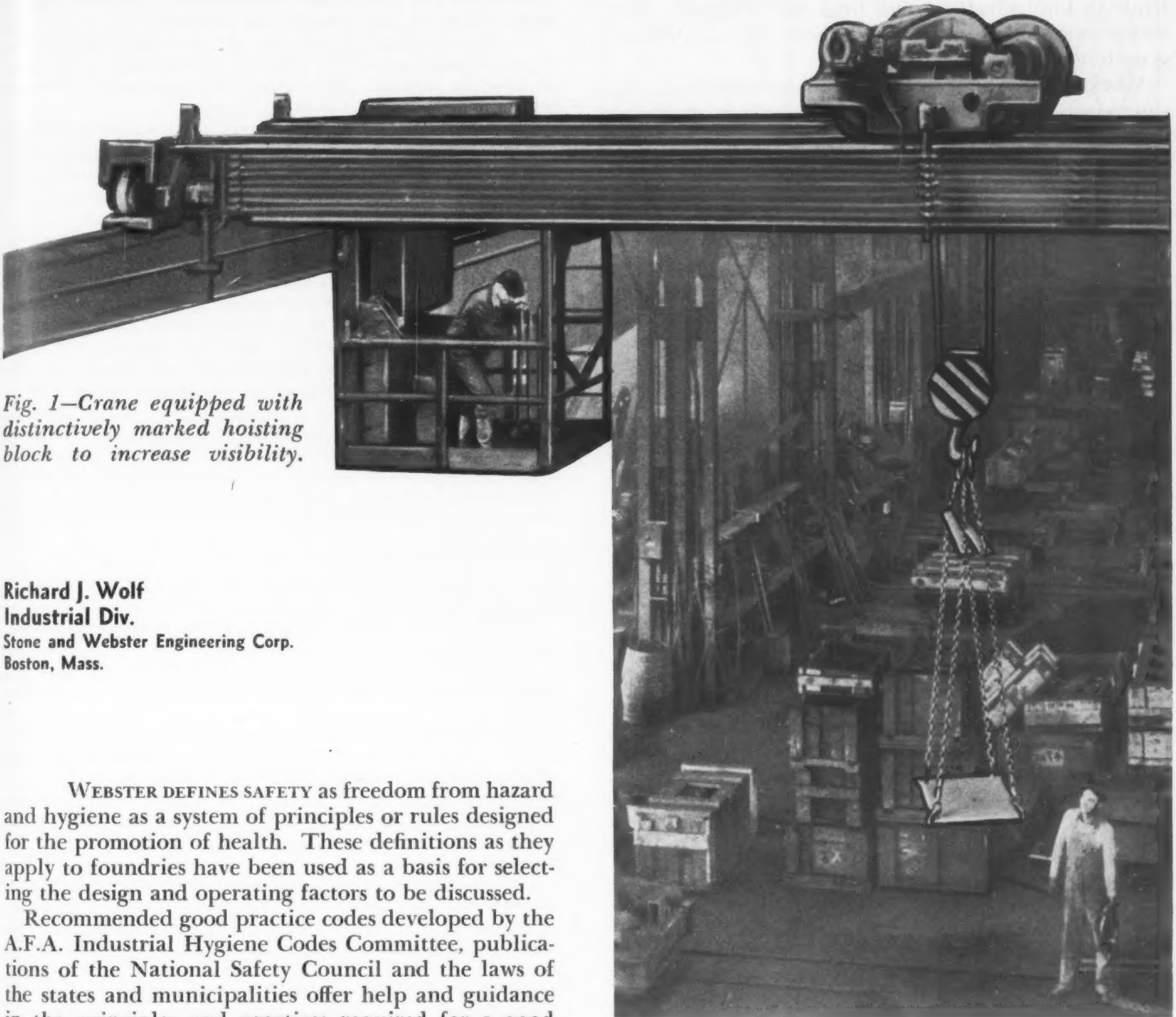


Fig. 1—Crane equipped with distinctively marked hoisting block to increase visibility.

Richard J. Wolf
Industrial Div.
Stone and Webster Engineering Corp.
Boston, Mass.

Webster defines safety as freedom from hazard and hygiene as a system of principles or rules designed for the promotion of health. These definitions as they apply to foundries have been used as a basis for selecting the design and operating factors to be discussed.

Recommended good practice codes developed by the A.F.A. Industrial Hygiene Codes Committee, publications of the National Safety Council and the laws of the states and municipalities offer help and guidance in the principles and practices required for a good safety and hygiene program. If the best working conditions are to be achieved, bare compliance with state and municipal laws is not sufficient nor is the installation of safety equipment enough as it is of little value unless maintained in first class operating condition.

Design of foundry buildings is too extensive a subject to be covered in this article except to state that they should be of fire resistant construction, have ample natural and artificial lighting and good ventilation. Engineers can design foundries which are safe, clean places in which to work, but keeping them in this condition is the joint problem of employer and employee.

In setting up a safety and hygiene program, it is of the utmost importance to place the responsibility for its execution on one man for in no field does the old truism, "everybody's business is nobody's business," apply more aptly. Depending on the size of the foundry the personnel required for the successful execution of the program may vary from one man part time to a full-time staff. It is essential that the head of the program shall have direct access to top management so that recommendations can not be blocked by unsympathetic subordinates. Enthusiastic support by top management is also essential for the successful execution of any safety and hygiene program.

The first and most important part of the safety program is the training of supervisors and workmen. The use of small discussion groups rather than lectures has proved very successful in training supervisors in good safety and hygiene practices. In order for this procedure to be effective the group leader must have a well-developed program worked out and the discussion must be kept strictly to the program.

Meetings should be held every week or every two weeks until the program is well under way. After the program is well established the period between meetings can be lengthened, but should never be longer than one month. Motion pictures or lectures can be used to vary the program.

In small foundries the entire supervisory force may comprise the discussion group, while in large foundries, where more than one group is formed, one man from each department might be selected for each discussion

group. It is desirable that the meetings be held during working hours and that the supervisors not be required to give up their own time, as this creates resistance and tends to hinder rather than help the program. The meetings should not last over one hour, and a half hour is preferable.

Workmen can be trained in the same manner as the supervisors. The meetings should be held in the shop, with each supervisor handling his own men. The discussions should be entirely informal and the men encouraged to talk freely; no minutes should be kept.

Suggestions from the men should be promptly investigated and the action taken by management reported. Where unsafe conditions are reported they should be corrected without delay. Prompt action on employee suggestions stimulates interest and cooperation with the safety program. The meeting should be brief; not over 15 minutes.

Statistics compiled monthly which record the number, type, severity, and cause of accidents, highlight unsafe practices and working conditions. They are an excellent guide as to where extra effort should be expended, and indicate the effectiveness of the program. These statistics can be used in both supervisors' and workmen's meetings.

One of the cornerstones of an effective safety program is a printed set of "Foundry Safety Rules," which should be distributed to every employee, supervisor and executive. These rules form a basis for safety meetings and act as guide in the detection and correction of unsafe working practices and conditions. They are extremely valuable in training new employees and eliminate the possibility of overlooking important items in the safety program. A set of "Foundry Safety Rules" which have been used successfully in a large foundry making medium and heavy castings are included in the paper. Not all of these rules apply to every foundry. They are presented only as a guide.

FOUNDRY SAFETY RULES

This booklet contains general safety rules applicable to all employees. Established plant conduct rules and regulations are likewise set down for your information.

If you lose this book, you should obtain another copy from your foreman, safety inspector, or at the employment office.

To New Employees—The management and fellow employees of "X" Foundry Co. welcome you as a member of the organization. Foremost in the minds of all must be accident prevention. Safety is the responsibility of each one, and of all collectively, in the company. Hence, as you begin your employment we want to impress upon you our serious attitude toward knowledge and observance of the safety rules and compliance with safe practices. This is your first and greatest responsibility. May your employment with us be safe, pleasant and profitable.

To Foremen—Responsibility for safe conditions and practices in your department is yours! Give first consideration to the safety of those you supervise. Make certain that subforemen and gang leaders under your supervision do likewise.

You and all those you supervise should acquire a full knowledge and understanding of safety and operating rules stated herein and all other rules which now exist or may hereafter be established. Knowledge leads to understanding and understanding brings cordial and cooperative work relationships.

Many accidents, which in the past have been ascribed to carelessness, have occurred because the employee did not know the proper method of doing his work. Do not assume that he knows anything about the job. Give him personal attention or place him under the guidance of an experienced workman who is qualified to train him. Tell him how, show him how, test and check his knowledge of what you have told him and shown him. Be patient but persistent. Learning is a slow process and none of us ever entirely finishes it.

It is a well-established fact that employees who have been transferred from other departments experience almost as many accidents as newly hired employees. You and all employees, therefore, should be as attentive to their safety as though they were new employees. Show them the new hazards and teach them how to avoid them.

If it is necessary for you to send your men to another department, make arrangements with the supervisory forces of that department to provide for safe working conditions.

Foremen should hold a safety meeting with their men at least once a month.

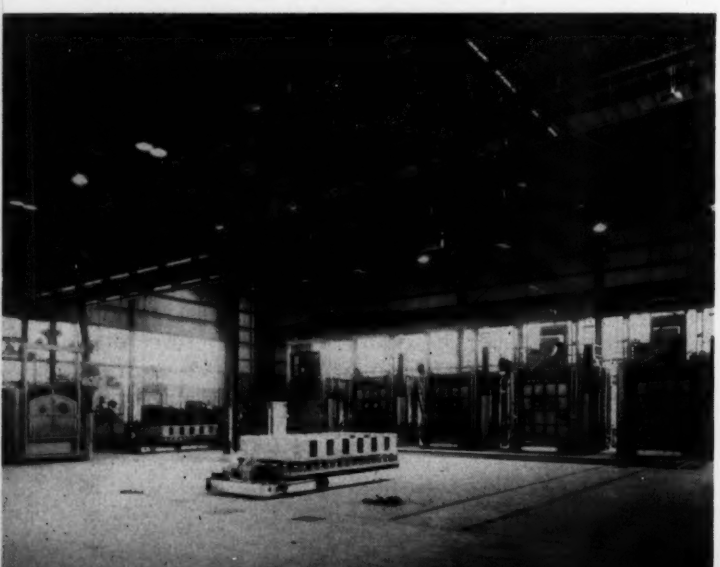
Safe practices in any department will be among the influences prompting top management to consider supervisors for promotions.

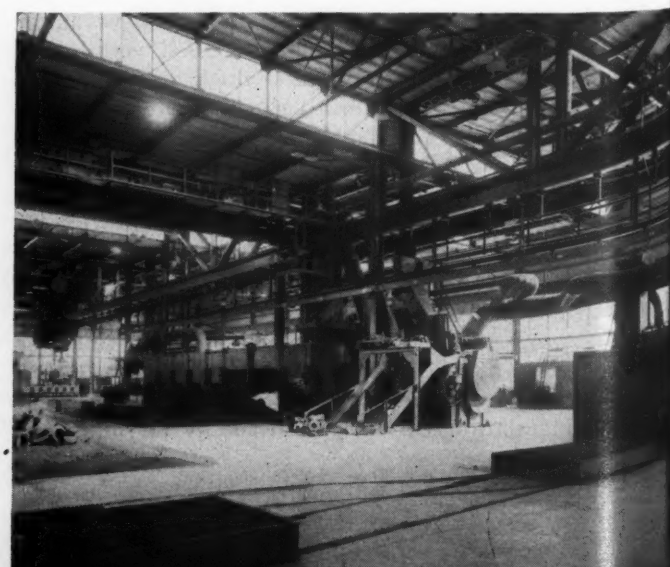
To All Employees—Management earnestly requests your continued cooperation in preventing accidents. Safety is not the responsibility of the safety department, the foreman, the experienced employee, or the new employee, alone; it is the responsibility of every employee every minute of the day and night whether he be at work, at home, or on the highway. Your responsibility for safety never ceases.

You are expected to use proper care in your work for the sake of your own safety and that of employees working with you or near you. If your fellow workman is careless or performs his work improperly, call his attention to it. He should thank you for it. If he persists, report it to your foreman. Safety can be accomplished only through complete employee cooperation.

Be watchful for the safety of visitors; they may not be familiar with the operations. If you see them standing where they are

Figs. 2 and 3—Annealing room (left) and cleaning room (below) which are well lighted, ventilated, and provided with ample floor space in working areas.





likely to be injured, tell them courteously where they should stand to be safe. They are your guests and should be treated as such.

Every employee should know and understand the general safety and operating rules and the safety rules pertaining to his department.

If your work requires you to enter other departments, familiarize yourself with the rules and the hazards of those departments.

Unusual Hazards—If you encounter conditions of great or unusual hazard with which you are not familiar, go to your foreman for proper instructions before you proceed. Under no circumstances should you take unnecessary risks.

Sickness—If you feel sick or if you believe anyone working with you is sick, report the case to your foreman immediately. This is particularly called to your attention in cases of heat exhaustion. Ask the foreman to send the man to the doctor for observation, and by all means do not have the man go home without first receiving medical attention.

Injuries—Report all injuries to your foreman *no matter how slight.* Infection develops quickly even from a tiny scratch. You may consider that it does not *"amount to anything"* but do not take a chance. Report to your foreman and then go promptly to the medical department for treatment.

If you see any condition in your department which looks dangerous to you, report it to your foreman.

Read the bulletin boards. We should all profit from the thoughts and experiences of others.

Good housekeeping is not only a mark of distinction, thrift, and breeding but transplanted to work areas it reflects the home influence and makes for improved quality of man and product. A clean shop is a safe shop.

General Safety Rules

1. Wearing Apparel—Wear no loose or ragged clothing, long neckties, or finger rings around moving machinery. All are dangerous. You are expected at all times to wear shoes that are in good condition. We urge you to wear safety shoes. They will prevent injury to your toes. Gloves must not be worn when you operate machines such as lathes, milling cutters, boring mills, drill presses, etc., with revolving spindles and cutting tools without the consent of your foreman.

Do not wear oxfords in the foundry—you may get your feet burned with hot sand.

When unloading silica flour, fire clay or other fine dusty material wear a respirator. Be sure it is clean. It is of no value if dirty. Your foreman will get you new filter pads.

All men engaged in pouring a heat must wear goggles, leggings and asbestos coats.

2. Eyes—Do not attempt to remove any foreign body from the eye of another employee. He should report to his foreman and go immediately to the dispensary for medical treatment.

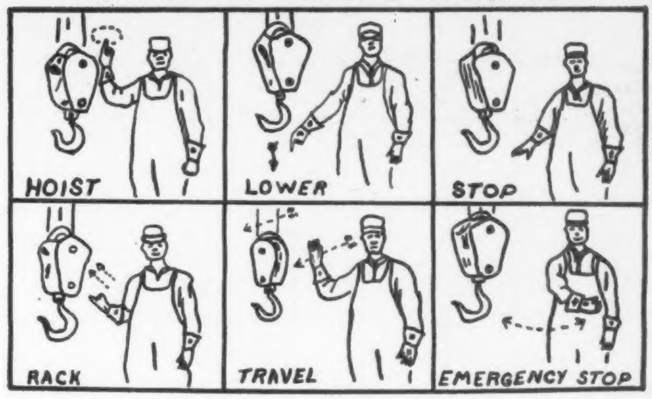
3. Goggles must be worn wherever and whenever there is evident danger to the eyes. Goggles are furnished by the company free of charge and may be had from your foreman. The following is a list of occupations in which the use of goggles is compulsory:

Chipping iron, steel and other metals
Stripping bolts and rivets
Grinding
Dressing emery wheels not fully protected with hood and eye shield
Handling or pouring acids or caustics
Oxy-acetylene or electric welding or cutting
Sand blasting
Splicing and cutting cable
Drilling or breaking concrete, brick, stone, slag, or coal

4. Safety Belts—Whenever it is necessary for you to work in elevated places not protected by standard railings, or in bins where material is unloaded, wear a life belt with life line properly adjusted and secured to keep you from falling. Have an attendant stationed nearby to help in an emergency.

5. Starting Machinery—Do not turn on any electricity, gas, steam, air, acid, or water, or set in motion any machinery without first making sure that no one is in a position to be injured. Proper signals and precautions shall be adopted to insure that all who may be in dangerous places may be plainly warned that such machinery is about to start. Ample time must be allowed for every one to get in the clear.

STANDARD CRANE SIGNALS



While electrically driven machinery is under repair, the main switch must be locked in the open position by the individual in charge of the repair job. Where more than one gang is working on the same job, each gang must be protected by its own locks. Locks shall be removed only by the person who placed them.

Never remove a danger tag or sign for any reason whatever unless you placed same.

Do not attempt to operate, repair, or test any machinery, electrical apparatus, or other equipment unless it is a part of your assigned duties to do so. Do not meddle or experiment with equipment with which you are not familiar.

6. Oiling Machinery—In all cases where intermittent operation is practicable, *stop machinery before attempting to oil, clean, or repair it. Do not try to oil, clean, repair or operate a machine you do not understand.*

7. Defective Machinery and Tools—If any tool, machine, or other piece of equipment is not in safe working order, do not use it until it has been repaired. Report it to your foreman.

8. Guards—Machine guards and other safety devices are provided for your protection. They must not be removed except for making repairs and then only by authorized persons. They must be replaced before starting the machine.

9. Working Overhead—Whenever it is necessary for you to work overhead, warn those below and place a *"Danger—Men Above"* sign so that anyone who passes will see it. Do not drop material from above until you have given warning to those below.

10. Railroads—Do not go under a locomotive or car for any purpose unless your work requires it and then only after a red flag or red light is displayed at least two car-lengths from both ends. Only the same workman who places the red signals is authorized to remove them. Locomotives and cars protected by red signals must not be coupled or moved.

You are positively forbidden to ride upon locomotives, railroad cars or other transportation equipment except in line of duty. Do not crawl between, under, or over cars.

Whenever it is necessary to set cars on a track which is protected with red signals, arrangements must be made to have signals reset to protect all cars on the track.

Do not remain in cars which are being switched. Get out of the car and stay out until the switch has been completed and the protective red signals replaced.

11. Cranes—Do not go on an overhead crane runway, for any purpose, without permission from your foreman, and then not until the craneman has been notified.

No one except those authorized by the foreman shall be allowed to operate cranes. Wherever practicable crane hookers shall walk ahead of loads carried by cranes, and cranemen and hookers must see to it that workmen on the floor are in the clear.

A craneman must not make a lift or move his crane, regardless of signals, if, in his judgment, someone is in a position to be injured or the load is not securely hooked.

A craneman must not move a lift without standard signals from a properly designated person. He should take signals from one man only.

Workmen must not stand inside cars while they are being loaded or unloaded by magnet or grab-bucket.

Do not ride on loads being carried by cranes.

Be alert. Do not stand or walk under loads suspended from cranes. Listen for the crane bell or other signaling device. Hookers must see that no one is in a position to be injured while lift

TABLE 1 — SCHEDULE FOR SAFE LOAD LIFTING

Rope Diam. In Inches	CHAIN				WIRE ROPE				MANILA ROPE				SISAL ROPE			
	90°	60°	45°	30°	90°	60°	45°	30°	90°	60°	45°	30°	90°	60°	45°	30°
3/8	1,800	1,550	1,250	900	2,050	1,750	1,450	1,000	200	170	140	100	100	85	70	50
1/2	3,000	2,600	2,100	1,500	3,700	3,200	2,600	1,850	340	290	240	170	170	145	120	85
5/8	4,600	4,000	3,250	2,300	5,600	4,850	3,950	2,800	560	480	400	280	280	240	200	140
3/4	6,750	5,850	4,800	3,400	8,050	7,000	5,700	4,000	690	600	490	350	345	300	245	175
7/8	9,350	8,100	6,600	4,670	10,800	9,350	7,650	5,400	980	850	690	490	480	425	345	245
1	12,400	10,700	8,750	6,200	14,000	12,100	9,900	7,000	1,150	1,000	810	580	575	500	405	290
1 1/8	15,600	13,500	11,000	7,800	17,600	15,200	12,400	8,800	1,550	1,350	1,100	780	780	675	550	390
1 1/4	19,200	16,600	13,600	9,600	22,000	19,000	15,500	11,000	1,750	1,500	1,250	880	875	750	625	440
1 3/8	23,000	19,900	16,300	11,500	27,200	23,600	19,200	13,600	2,240	1,950	1,600	1,100	1,120	975	800	550
1 1/2	27,200	23,600	19,200	13,600	32,000	27,700	22,600	16,000	2,450	2,100	1,750	1,200	1,225	1,050	875	600
1 3/4	35,000	30,300	24,700	17,500	43,200	37,400	30,500	21,600	3,550	3,100	2,500	1,800	1,775	1,550	1,250	900
2	44,400	38,500	31,400	22,200	52,000	45,000	36,800	26,000	4,200	3,650	2,950	2,100	2,100	1,825	1,475	1,050
2 1/2	65,600	60,300	49,200	39,800	85,600	75,100	60,500	42,800	6,100	5,300	4,300	3,050	3,050	2,650	2,150	1,525
3									8,550	7,400	6,050	4,300	4,275	3,700	3,025	2,150

is being raised or lowered. Keep all parts of the body away from lifts being lowered by crane.

Never use cables to handle hot castings. Always use chains for this work.

All heavy lifts should be handled with cables. For allowable loads see Table 1.

Do not move cranes in the pouring zone when a heat is being poured.

Be sure all plates and flasks are securely clamped before picking them up with a crane to move or roll them over.

Have your hands free when hooking for a crane lift.

Hookers should never ride crane hooks or loads.

Crane operators—you are responsible for the safety of the men on the ground. Be alert, careful, and do not take chances.

Operators must "feel" their load before making a lift.

Cranes should be tested and oiled before foundry working hours.

Whenever an operator burns a cable it should be reported to the foreman before making another lift.

Each operator shall test his crane limit switch before starting his day's work.

Operators must sound bell before moving a load.

If the operator is in doubt about a lift he should consult a foreman before making the lift.

Keep cables straight, a kink quickly weakens them.

12. Ladders—Do not use defective ladders. When necessary, to prevent slipping, either tie the ladder securely or have another workman hold it.

13. Scaffolds—Never use "make-shift" nor defective scaffolds. If your duties require you to build scaffolds, consult your foreman for instructions.

14. Oxygen and Compressed Air—Use oxygen and compressed air only for the jobs for which they are intended. Do not clean your clothes with them; do not blow them against anyone. They may enter his body and injure or kill him.

Only qualified operators are permitted to use oxy-acetylene cutting and welding equipment.

If your duties require that you use oxygen, acetylene or other gases, ask your foreman for a book of instructions.

15. Piling Material—When you pile any material, make sure to arrange it so that it will not fall, and it will not cause some other pile to fall.

Stack empty flasks carefully. Poorly stacked flasks may fall and cause serious injury.

16. Loading Material—Load material on cars carefully so that no portion will project over the car side or fall off in transit.

17. Fire—Report fires immediately to the telephone operator. Report the location of the fire, your name, and telephone number from which you are calling.

Know where the fire extinguishers are and how to operate them.

After a fire extinguisher has been used, notify your foreman whose duty it shall be to see that proper replacements are made promptly.

18. Electric Light Bulbs—No persons except those duly authorized by the electrical department shall change light bulbs.

19. Good Housekeeping—Keep the floor clean and level where you work. Pick up and pile neatly all gaggers, clamps, rods, pipe, etc.

Throw old paper, food, clothes, wire and worn-out wedges into the trash barrels which are conveniently located.

Do not leave old boards with nails in them on the floor.

When finished with a pattern see that all loose pieces are attached and the pattern is removed from your floor. Notify a pattern checker when a job is completed.

20. Open Hearth—Safety goggles must be worn when opening or making up the tapping hole.

Safety goggles must be worn when breaking test pieces.

Colored glasses must be worn whenever a man looks into the furnace.

Brush off all snow from the charge and furnace addition before putting it in the furnace.

Ladles must be thoroughly dry and hot before tapping heat.

Be sure ladle stopper seats securely before tapping the heat.

Ladle stoppers must be thoroughly dry before they are used.

Slag must not be tapped or tapping hole blown out without first notifying men working on the floor and slag pit.

21. Miscellaneous—Never distract the attention of another workman. You may cause him to be injured.

Horseplay and "fooling" including wrestling and throwing material are forbidden in working areas. Many serious accidents are caused in this manner.

All excavations, open manholes, pit molds and other places where persons might fall should be suitably guarded. Report any not guarded.

Go to all safety meetings you are asked to attend. These meetings are to help make the foundry a safer and better place to work for you and your fellow employees.

Be alert and careful at all times.

22. Do Not Take Chances—Do not lay your shovel down with the blade pointing up. Turn it over so the blade is on the ground.

Brace securely all copes when they are standing on edge.

Keep your floor wet down and reduce the dust in the foundry.

Sprinkle hot sand. Do not put a nozzle into the hot sand and turn on the water; someone may get burned.

Do not work where men are working over your head. They may drop something and cause serious injury.

If you are not in the pouring gang keep away from the ladle when a heat is being poured.

When using a hand hammer or sledge be sure no one is behind you who might get hit.

In lighting ovens or drying or soaking pit burners, make a swab, soak it with kerosene and light. Place lighted swab on burner before turning on the gas.

Be sure castings are cold before touching them with your hand. You can get a bad burn from castings that look cold.

No person who is intoxicated or under the influence of liquor will be permitted to work in the foundry.

Whenever in doubt about the safe way to do a job consult your foreman. Do not take a chance.

The installation of proper equipment is only slightly less important than employee training. The equipment manufacturers and safety engineers have contributed to safety by improvements in the design of equipment used in the foundry.

Important among these improvements are:

A. Cranes

1. Dynamic lowering control.
2. More positive limit switches.
3. Better hoisting cable including preformed cable and steel-cored cable for handling hot metal.
4. Safety latches on the hoisting hook.
5. Enclosed conductor bars.
6. The installation of master switches which can be locked open has materially helped reduce accidents during periods in which a crane is down for maintenance. It is good practice to have the supervisor of each group of mechanics working on a crane place his lock on the switch. This prevents starting the crane before all the men are off.
7. The installation of red lights which are turned on when a crane is not in operation and warns the operators on other cranes that this crane should not be moved.
8. Painting the cranes a distinctive color such as white, aluminum or yellow, which contrasts with the remainder of the foundry helps materially in reducing the number of crane accidents.
9. Painting the hoisting block with alternate black and white or black and yellow stripes makes it easy to see and aids in accident reduction (Fig. 1).

B. Monorail Systems and Electric Hoists

1. The design of high carbon steel monorail track with a flat tread reduces the force required to move a load and lessens operator fatigue on manually operated systems.
2. The use of shielded conductor bars helps materially in reducing the possibility of electrical accidents.
3. The interlocks at switches and crossover points which are designed so that stops are automatically in place when the switch is open, almost completely eliminated trolleys running off the rail at these points.
4. Electric hoists for handling hot metal are now manufactured with the cable reeved two double with one end of each cable fastened to an equalizer bar. With this reeving the load will not drop if one cable breaks. The use of heat shields and steel cored cable are also recommended for this service.
5. Variable speed control for hoisting and travel contributes materially to the safe handling of heavy loads.

C. Core Ovens and Annealing Furnaces

The installation of automatic combustion controls and a device which will shut off the fuel supply if the flame goes out materially reduces the possibility of an explosion due to this type of failure. Exhaust fans located in the stack are also recommended to prevent the accumulation of explosive mixtures.

General Safety Practices

Crane cables should be inspected regularly, and if charring of the hemp core, excessive wear, or many broken wires are in evidence, the cable should be replaced.

Steel or wrought iron chain should be annealed at regular intervals, as chain crystalizes with use. It should be carefully inspected and damaged links replaced. In cold weather chain should be kept warm, as long exposure to cold causes brittleness which results in failures.

Care should be taken to prevent kinking cables as this shortens their life and greatly reduces strength.

Figs. 4 and 5—Dust collecting methods at shakeout for snap molds (left) and at vibrating shakeout (below).

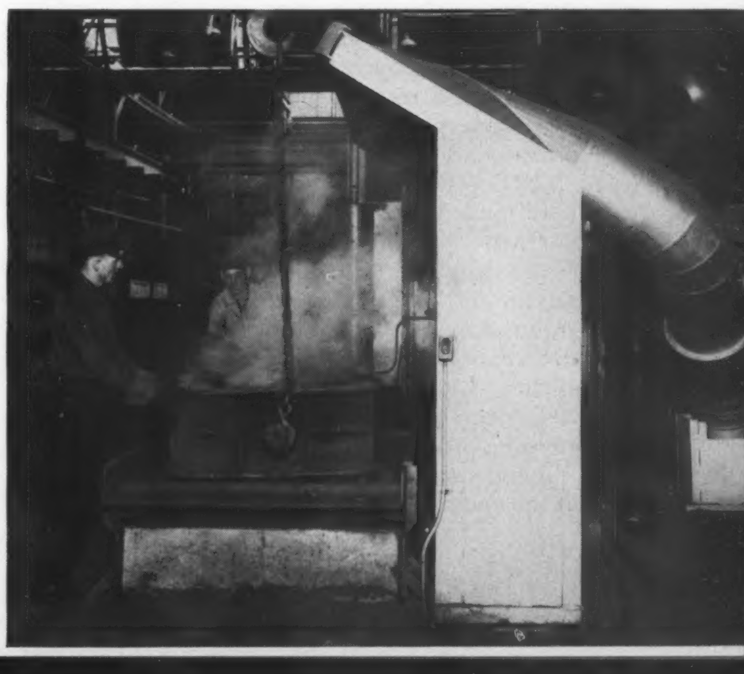


Fig. 6—Method of fume collecting at pouring station.

Table 1 shows the changes in allowable load on chains and cables as the included angle increases.

Blast-cleaning booths where the operator works inside should be equipped with a light on the outside to indicate when the unit is in operation. An emergency shut-off switch should also be located outside.

The sandblast operator's air supply should be from a blower designed to deliver air free from oil and carbon monoxide. Compressed air from the plant system should not be used without a suitable pressure-reducing valve, and filters to remove oil and carbon monoxide. The operator's helmet should be kept under a small positive pressure to prevent dust from entering.

All gears, belts and chain drives should be enclosed in correctly designed guards.

Stairs should be used wherever possible rather than ladders, as they reduce the possibility of accidents. Walkways and stairs should be equipped with suitable railings, and ladders should be enclosed.

Provide Ample Space

Ample room should be provided around equipment for maintenance and repairs. This will not only help create safe working conditions, but will result in better maintenance. It is well known that when equipment is placed in obscure cramped positions it is neglected.

Provide ample working space at all times. It is not only safer, but production is increased. (Figs. 2 and 3).

The use of portable screens around chipping and oxyacetylene cutting operations, to control sparks, slag and flying chips, is recommended.

Hand hammers and sledge hammers should be inspected for loose or cracked handles and mushroomed heads. The defective parts should be replaced promptly. Where mushroomed heads are found on hammers and chisels they should be ground flush.

Chipping chisels for air hammers should be regularly inspected for cracks and notches, which some operators grind into the shanks for identification, as these marks cause stress concentrations which result in chisel failure and injuries. Chisels should be drawn and tempered by an experienced mechanic, and the individual chipper should be prohibited from attempting this work.

Air rammers should be turned into a central tool room at the end of each shift for oiling and inspection. Loose rammer heads should be repaired before use.

Protective clothing, leggings, goggles, safety shoes, etc., contribute materially to the reduction in foundry accidents. This equipment falls into two categories, that furnished by the employer, and the employee.

Leggings and coats of fire-resistant material should be worn by pouring crews handling large and medium-sized ladles. Men using hand shanks should be required to wear leggings. The leggings should cover the instep and be so designed that they fit snugly but can be quickly removed. When leggings are of the knee length type the pants leg should be pulled up sufficiently to form a protective fold over the top. This prevents the entry of hot drops of metal into the tops of the leggings.

Employees should be encouraged to wear good fitting, sound clothing. Many accidents are caused by loose, ragged clothing catching in equipment.

Eye protection equipment should be worn by chippers, welders, melters, blast cleaning machine operators, pouring crews, workers handling acid, and supervisors working in these areas. The type of protection worn may be goggles, face shields, safety spectacles or helmets, depending on the type of work. The resistance to wearing eye protection which is often encountered can be materially reduced by training a man to fit goggles and spectacles properly. Men who wear corrective glasses can be fitted with cover goggles or, better still, provided with safety lenses ground to prescription.

Using Goggles and Respirators

Employees requiring corrective lenses can be sold much easier on wearing one pair of goggles instead of two. In addition to proper fitting, good maintenance is essential if the maximum benefits are to be derived. In large plants it is desirable to have the goggle maintenance man make regular scheduled rounds of the plant. He should be equipped with a repair cart so that he can service goggles in the working areas.

It is always preferable to confine dust and fumes rather than require employees to wear respirators. However, there are conditions where the use of respirators is the most practical means of providing protection. Typical examples of such conditions are manual unloading of sand and silica flour, and with night shakeout crews where this work is done at a centralized location where the dust can be confined.

Every employee should be encouraged to wear steel-toed safety shoes, as they materially reduce foot injuries. The desirable type varies with the type of work. Oxfords are satisfactory for clean work areas such as corerooms, while high shoes are necessary on the molding and pouring floors. Congress gaiters, which can be easily removed and have no laces to catch hot metal, are most desirable for pouring crews. It is most essential, regardless of the type of shoes worn, that the soles be thick and sound so that heat from hot metal spills or nails can not penetrate and injure the feet.

As good housekeeping is one of the major factors in foundry safety, every effort should be made to train employees to keep the work areas clean and orderly, to carefully pile material and keep tools in their proper places. Management should provide clamp racks, boxes for gaggers, and refuse boxes at convenient locations. The labor force should be ample to do the necessary cleaning, which can not be done by production men.

The engineer provides adequate windows and electric lights so that the lighting will be ample at all times, but this is of no avail if the windows and lighting fixtures are not kept clean. Good light is important to good safety practice.

Handling Gas Cylinders

Foundries using oxygen and acetylene for cutting and welding should train employees using this equipment in its use, maintenance and handling. The major companies producing these gases have prepared excellent books on this subject, and every burner, welder or trainee should be supplied with a copy. All employees should be familiar with the following rules:

1. Avoid abusive handling of cylinders.

2. Cylinders should be stored only in approved, safe places.

(a) Store cylinders in definitely assigned places where they will not be knocked over or damaged by passing or falling objects.

(b) Cylinders should be kept away from stoves, radiators, furnaces or other hot places. They should be stored well away from highly combustible material such as oil, grease or excelsior.

(c) Inside buildings, cylinders of oxygen should not be stored in the same compartment with cylinders of acetylene or other fuel gas. Unless they are well separated, there should be a fire-resistant partition between the oxygen cylinders and acetylene or fuel gas cylinders.

(d) Where cylinders are stored in the open, they should be protected from accumulations of ice and snow, and from the direct rays of the sun. Cylinders containing oxygen should be placed well away from cylinders containing combustible gases.

(e) Regulations of the National Board of Fire Underwriters and any local, state and municipal regulations on cylinder storage should be closely followed.

3. While cylinders are being moved, keep them from being knocked over or from falling.

When moving cylinders by crane or derrick, use a suitable cradle, boat, or platform. Never use slings or an electric magnet.

Wherever practicable, suitable trucks should be provided for conveying and handling cylinders.

Unless cylinders are on a suitable truck, regulators should be removed and valve protection caps should be put in place hand-tight when cylinders are moved. Always close cylinder valves before moving cylinders.

4. Never use valve protection caps for lifting.

5. Never use cylinders as rollers or supports even if they are considered to be empty.

6. Keep cylinders from being upset while in use.

7. Never allow cylinders to come in contact with live wires, third rails, or electrical equipment ground wires.

8. Always close cylinder valves when work is finished, and always close valves of empty cylinders while in storage prior to return and while being returned to the supplier.

9. Always call oxygen by its proper name—"oxygen."

10. Never permit any open flame to come into contact with any part of a cylinder.

11. Never use oxygen from a cylinder except through an oxygen regulator.

12. Do not use a hammer or wrench to open oxygen cylinder valves.

13. Keep oxygen cylinders and fittings away from oil or grease as they may ignite violently in the presence of oxygen under pressure.

14. Never tamper with nor attempt to repair oxygen cylinder valves.

15. Call acetylene by its proper name—"acetylene."

16. In storing cylinders, remember that acetylene is a fuel gas.

17. Always stand acetylene cylinders valve end up.

18. Never tamper with fuse plugs.

19. Should the valve outlet of an acetylene cylinder become clogged with ice, thaw with warm—not boiling—water.

20. Never use a cylinder that is leaking acetylene.

21. Always use the special T-wrench or key for opening or closing the cylinder valve.

22. Do not use the recessed top of the cylinder as a place for tools.

Employees who are required to use pneumatic chipping hammers should be trained so that they know how to hold the hammer and chisel to reduce the possibility of hand injuries and keep fatigue to a minimum. They should also be trained to use screens to deflect flying chips, and to use care in running the air hose in a manner which does not constitute a hazard to other employees. When hammers are laid aside for short periods, care should be taken to place them so that they can not be accidently discharged. When not to be used for an hour or more, the air should be shut off.

Figs. 7 and 8—Arc melting furnace before (left) and after (below) installation of fume collector equipment.

Fig. 9—Good housekeeping in metal storage yard.

The use of makeshift ladders should be discouraged. Management should provide sound ladders, equipped with safety feet as required. Ladders should be inspected regularly and replaced if they show signs of weakness, such as bad cracks or deep burns. Broken rungs should be replaced and loose rungs fastened.

Scaffolds should be made of clear, straight-grained lumber, free from large knots, or of steel pipe. They should be adequately cross braced and the working platforms attached securely. A safety railing should be securely fastened around the working platform. In general, access ladders should be attached to the scaffold. Ladders, when set in a vertical position, should be equipped with safety enclosures.

In addition to training employees in the care and use of equipment, they should be taught to lift with their legs rather than with backs and arms, as this method reduces the possibility of producing a hernia. Training men to exert their strength properly when doing heavy manual work will help reduce accidents.

Hygiene

Hygiene as defined covers those phases of plant operation and design which contribute to maintenance of the health of the employee.

One of the most important hygiene features in any foundry is the suppression and collection of dust. The first rule in this program is to reduce, insofar as possible, the generation of dust. This is accomplished by keeping concrete floors clean and wetting down dirt floors. Overhead steelwork, walls, roofs and cranes should be cleaned at intervals. Vacuum cleaning units of both the portable and central system types are a material aid in keeping a foundry clean. Tests have shown as much as 40 tons of dust adhering to the overhead structure of a medium sized foundry building. It is desirable in the design of foundry buildings to keep to a minimum the number of locations at which dust can accumulate on overhead structures.

Dust and fumes which can not be prevented by the procedures outlined in the foregoing and which are detrimental to the employees' health must be collected. The problem of dust collection is much too large to be covered adequately in this paper. It is sufficient to point out that the major dust and fume generating equipment which can be isolated and provided with special dust or fume hoods are:

1. Sand preparation and handling systems. Exhaust hoods should be provided at mullers, vibrating and rotary screens, dry sand storage bins and the junction points of all belt conveyors handling the dry sand.
2. Shakeout units both vibrating and stationary (Figs. 4 and 5).
3. Pouring and cooling sections of continuous mold conveyors (Fig. 6).
4. Arc melting furnaces (Figs. 7 and 8).
5. Crucible melting furnaces.
6. Blast cleaning barrels and rooms.

It is suggested that consideration be given to providing the following number of air changes per hour for the various sections of a foundry.

1. Melting area—ten changes where units are provided with fume hoods. If no fume hoods are used 20 changes should be made.
2. Molding area: (a) Where continuous pouring is done on a moving conveyor equipped with pouring and cooling fume collecting system—ten changes; (b) where intermittent pouring is done during the working day—15 changes; (c) where pouring is done only once a day at the end of the shift, provision should be made to supply 20 changes per hour during the pouring period.
3. Coreroom—10 changes.
4. Sand preparation area—10 changes.
5. Cleaning room—10 changes.
6. Annealing and heat treating—10 changes.
7. Welding—20 changes.
8. Office—ten changes.

The air changes required may vary considerably from those given in the foregoing, depending upon conditions existing in the individual plant; they are presented only as a guide.

It is most important to maintain the dust collecting equipment properly so that it will function as designed. The effectiveness of many well designed systems is materially reduced by poor maintenance. Keep the ducts clean, the joints tight and remove large dents in the ducts that restrict air flow. Inspect the dust collectors regularly and replace wornout parts.

In the design of toilet and locker rooms the laws of the states and municipalities establish the minimum accommodations permissible. These may not always be adequate and should be increased if necessary to take care of individual plant conditions.

It is good practice to provide one closet for every 15 to 30 men, one urinal for every 30 to 40 men, one lava-

Fig. 10—View of dispensary in a modern large foundry.

tory for every 8 men or one wash fountain for every 50 men, and one shower for every 10 to 15 men. Approximately 6 sq ft of floor space should be provided for every locker to provide for aisles and benches.

The hot water storage tank should be of sufficient size to take care of 90 per cent of the peak demand. The size of the storage tank can be computed by figuring that a wash fountain or shower runs 3 to 5 gpm. Maximum demand periods are at lunch time and at the end of the shift. The water heater should have sufficient capacity to heat a full tank of water from 50 F to 150 F in one to two hours. Floor drains should be provided in a trough at the rear of the shower stalls and in the shower and locker room floors for handling the water used to wash down the floors. The floors should be sloped to the drains.

These rooms should be well lighted and ventilated, with a minimum supply of ten air changes per hour and exhaust 12 changes per hour. The difference between air input and exhaust is supplied by air infiltration around the doors and windows. Fresh air supply inlets should be located in the locker room and the exhaust in the shower and lavatory area.

The use of salt-glazed tile for the walls, and tile or terrazzo floors make these rooms easier to keep clean and free from vermin. Steel lockers and furniture are recommended.

Keep Washrooms Clean

In addition to designing wash and locker rooms which are of adequate size, well lighted and easy to maintain, it is important that they be kept clean. This involves not only sweeping and washing the floors, providing trash containers which are frequently emptied, but also the control of vermin, rodents and bacteria.

Accumulations of old, soiled clothing in employees' lockers is a source of strong, unpleasant odors and a breeding place for vermin. It is recommended that lockers be inspected at regular intervals to encourage cleanliness, and that they be washed out periodically with an antiseptic solution.

Trash barrels should be equipped with tight covers. The use of wood for floors, lockers, benches, tables and partitions should be kept to a minimum. Toilet seats should be nonabsorbent and sterilized at least once per day. It can not be too strongly stressed that proper care of toilet and locker rooms is a major part of good plant hygiene and preventive measures.

Collection of debris includes receptacles for its storage, collection and disposal. Receptacles should be metal containers, suitably painted and marked so that they can be readily recognized. Special tightly covered containers, distinctively painted, should be provided for oily waste and rags. Rubbish containers should be conveniently located, as the average employee will throw debris on the floor rather than walk any distance to put it into a container. Containers should be emptied daily and the contents burned wherever possible.

More attention generally is given to keeping the foundry clean than to policing the yard area. The accumulation of debris in the yard attracts rodents, which soon infest the buildings. Weeds and grass should be kept cut (Fig. 9).

Many foundries now require all applicants for employment to pass a physical examination prior to their being placed on the company rolls. This procedure has the advantage of weeding out men with serious physical defects or contagious diseases. It is recommended that this practice be expanded to include annual physical examinations for all employees.

The extent of the first-aid facilities in a foundry depends largely on the number of men employed and staff of trained personnel in attendance. In small foundries where all accident cases are sent out of the plant to a doctor or industrial dispensary, only the minimum of first-aid equipment is required. This should consist of a clean, well lighted room equipped with a cot, chairs, stretcher, sink with hot and cold water, and a first-aid kit. Several members of the supervisory and office staff should be trained in first aid.

Large foundries may have elaborate dispensaries with one or more trained nurses in attendance at all times, and a doctor on either a part- or full-time basis (Fig. 10). Good dispensaries are of material aid in preventing lost time due to infections resulting from neglect of minor injuries, and in reducing the time an employee is out due to lost-time accidents by providing prompt and competent care before the doctor arrives.

Experience has shown that reinforced concrete is satisfactory for general foundry floors, while hard-surfaced concrete such as granolithic is desirable for heavy trucking areas. Hard burned paving brick set in a sand cushion or in grout on a reinforced concrete slab makes an excellent floor for pouring areas and cleaning rooms for large castings. It does not fly like concrete when hot metal is spilled, wears well and is easily repaired. Some foundries prefer cast iron plates set in sand or concrete for gangways as they wear well and require very little attention.

All of these floors are easier to keep clean than dirt floors, and are therefore preferred. Where dirt floors are used it is essential that they be kept moist, level and well packed to provide a good working surface and keep down the dust. The floors in the closing and pouring areas of many foundries producing large work are covered with several inches of dry sand. This is excessive and should be reduced substantially so that the dust generated will be kept to a minimum.

In conclusion, successful foundry safety and hygiene programs are a function of top management and can be effective only if they receive enthusiastic support.

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National Malleable and Steel Castings Co.
Cicero, Ill.

EQUIPMENT USED in the annealing of malleable iron castings has improved greatly since the early days of the hand-fired periodic furnaces, and many more improvements will come in the next 25 years. This is certainly an indication that both malleable iron producers and furnace builders have been working steadily on the development of new annealing equipment.

It must be remembered that the class of work the foundry makes and the tonnage it produces are factors which influence the annealing equipment selected for a given operation. The smaller foundries, producing light work, must select furnaces with either pot type packing or arrangements for careful stacking in mind. If such provisions are not made, the castings will warp badly and straightening will be a serious problem. The larger establishments must choose equipment that will take care of large tonnages with a minimum of handling so that they will fit into a continuous operation.

Varying Annealing Cycles

Since the chemical composition of malleable iron may vary, the annealing cycle to be used will differ from plant to plant. Some of the equipment available is especially suited to fast-cycle iron, while other equipment is to be recommended for iron which takes longer to anneal. Therefore, a selection must be made on this basis also.

In order to discuss the modern annealing methods it will be best to mention the equipment now in use. The periodic furnace equipment can be classed as: (1) Periodic pot; (2) periodic muffle; (3) periodic car type radiant tube; (4) periodic car bottom muffle; (5) periodic shell and hearth radiant tube; and (6) periodic electric elevator.

The continuous equipment can be listed as: (1) Tunnel type kilns; (2) radiant tube pusher furnaces; and (3) electric pusher and roller hearth furnaces.

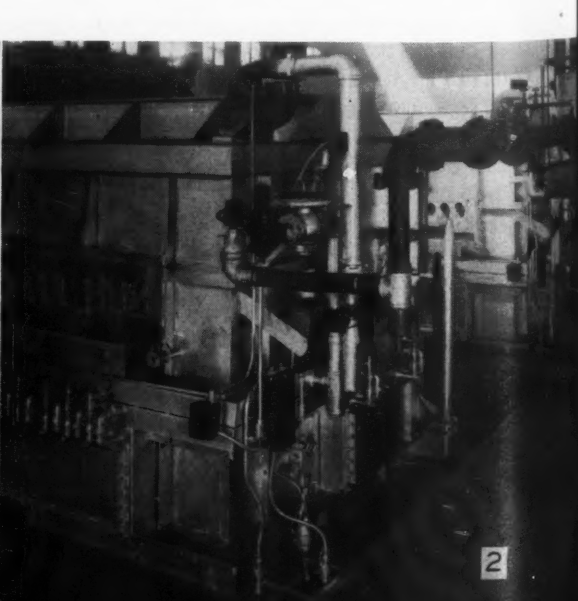
The periodic shell and hearth furnace, with radiant tubes in the shell, found early favor among steel producers who were looking for annealing equipment to produce scale-free sheet and strip. From this application it was only natural that the furnace found its way into the plants of malleable iron casting producers, and in this service it has produced good results.

All of the essential features of this equipment are shown in Fig. 1. In the foreground can be seen the hearth upon which castings are stacked. Next is a hearth which is packed and about to be covered with the shell containing the radiant tubes. Overhead is the crane which moves over the bank of hearths and lifts and lowers shells as needed. Figure 2 shows a close-up of the combustion control equipment for these furnaces. The easily assembled flexible coupling between the stationary gas line and the furnace can be seen in the center of this view. Figure 3 shows another type of radiant tube in a shell furnace, photographed in such a position that the tubes on the inside can be viewed.

The furnace equipment shown in Figs. 1, 2 and 3 has advantages in that loading and unloading can be done easily and without loss of valuable furnace time. Since air can be blown through the radiant tubes when cooling is desired, the drop in temperature from 1700 to 1400 F can be done quite rapidly. Scale-free castings are obtained by means of the positive sand seal at the intersection of the furnace shell and the recess around the hearth. An indication of the tightness of the furnace is the recording of atmospheres containing 65 per cent CO during the high temperature part of the cycle.

Work handled by these furnaces is limited to that which can be easily stacked (Fig. 1). Of course, it is also possible to load packed containers on the hearths, as is shown in Fig. 1. However, with a solid load of containers it would be necessary to increase the annealing cycle 25 per cent over the recommended 64-hr cycle.

1



2

Cost of this equipment per unit is greatly influenced by the cost of the crane needed to service the furnace loads. With an installation that will anneal about 500 tons of castings per month, a rate of depreciation comparable to other modern annealing equipment is indicated. Since the atmosphere produced in these furnaces is non-oxidizing in nature, the cost for alloy tubes and trays will be about $1.00 per ton of castings annealed. About 6,000 cu ft of 800 BTU gas is said to be consumed per ton of castings annealed.

Periodic car type radiant tube furnaces have found wide use in the malleable foundry industry. This equipment consists of a furnace chamber in which radiant tubes are both above and below the work. Castings are loaded on trays which are linked together and pushed or pulled into the furnace. Figure 4 shows a side view of a large installation, with the tube locations and burner equipment clearly evident. Figure 5 is an end view with a load waiting to be pulled into the furnace. In the background can be seen the temperature control panel.

Since the radiant tubes are near the work, both above and below, the batch type radiant tube furnace can heat the load rapidly to 1700 F. In a like manner, when air is passed through the tubes, the cooling from 1700 to 1400 F can be rapidly accomplished. These furnaces have been provided with an atmosphere gas generator which provides sufficient gas to maintain a positive pressure within the furnace, resulting in scale-free anneal.

As is seen in Fig. 5, the work annealed in these furnaces must be easy to pack. Medium sections give the best annealing results for the cycles generally used. As with all radiant tube furnaces, gas must be available as a fuel and must not be too expensive; but it should be said that the fuel cost will probably be lower than that for any of the periodic furnaces mentioned.

The alloy cost for tubes, trays and baskets depends upon the cycles used, and is considerably lower than the cost of pots in conventional equipment. Installations of this type have been in operation for more than 10 years and are still going strong, indicating that a low rate of depreciation may be anticipated.

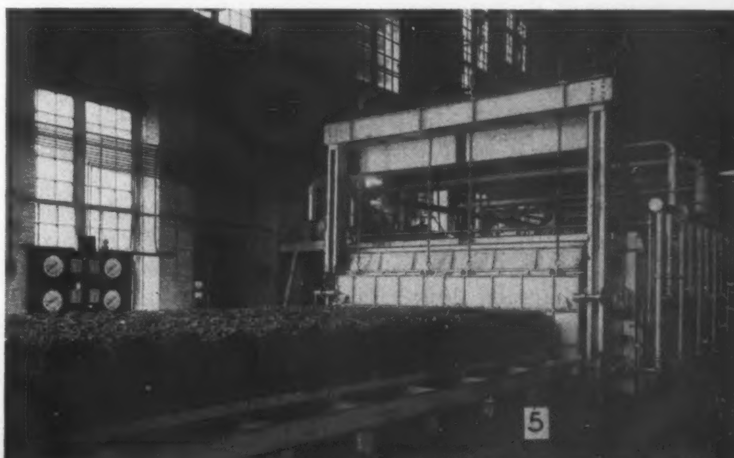
Probably the most commonly used furnaces are the periodic muffle and periodic pot furnaces. They have been in use almost since the beginning of annealing history and should not be classed as modern equipment, but their widespread use makes at least brief mention necessary.

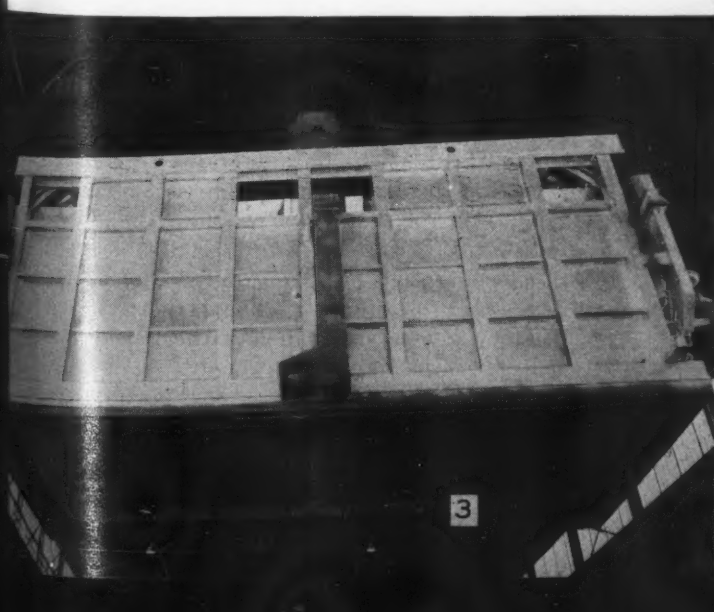
These furnaces are the least expensive to build, are not too expensive to maintain and have the lowest rate of depreciation of any of the equipment mentioned. Because of the non-conducting nature of the brick in the muffle furnace and the distance the heat must penetrate in the furnace, approximately 8,500 cu ft of 800 BTU gas will be consumed per ton of castings annealed.

This type of periodic equipment has disadvantages in that valuable furnace time is consumed in loading and unloading the work. As a result, many space consuming furnaces are needed for a given capacity where fewer furnaces would suffice if the loading and unloading were done without tying up furnace capacity. In addition, before any unloading can be done, the temperature of the work must be close to room temperature so that men can work in and around the furnaces. Since there is much brickwork to heat, the load comes up to heat slowly and cools just as slowly through the 1700-1400 F range.

The periodic car bottom muffle furnaces have recently received much attention. One installation has been built which utilizes a carborundum arch for the muffle, with cars being pushed into a ground-level fur-

Fig. 1—Installation of five radiant tube fired rectangular bell type furnaces and seven bases for malleableizing iron castings. Charge size 76 x 220 in. x 66 in. high. Fig. 2—Combustion control equipment for furnaces shown in Fig. 1. Fig. 3—Another type of radiant tube fired furnace. Fig. 4—Side view of periodic car type radiant tube furnace showing tube locations and burner equipment. Fig. 5—End view of furnace shown in Fig. 4 with load of castings ready to be pulled into furnace.





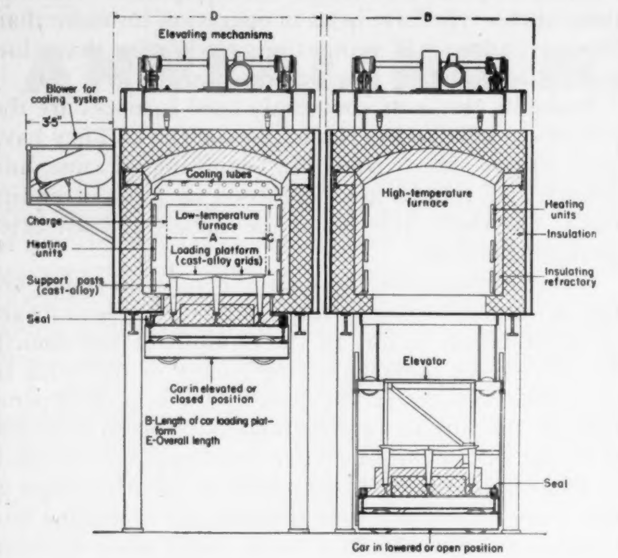


Fig. 6—Two-chamber electric elevator furnace.

nace. Some work has been done on a design which elevates a loaded car into a raised furnace chamber. This latter design has much to recommend it in that a positive sand seal can be easily achieved, thereby greatly simplifying the problem of atmosphere control. Both oil and gas have been successfully used as fuel for these furnaces.

Equipment of this type has the following advantages: loading and unloading can be done at central stations to and from which all work flows. Valuable furnace time is not consumed during the loading and unloading operations. Relatively rapid cooling can be achieved by means of allowing air to blow through the burner blocks and against the muffle arch during the range of 1700 to 1400 F. There is no alloy cost with these furnaces, and it is indicated that the maintenance costs will be quite low.

This equipment has disadvantages in that the class of work must lend itself to the making of easily stacked, dense loads. Pots or containers could be used, but this is not generally done. The sand seals around the car must be tight and the door must be properly sealed. If the furnace is not properly sealed, leakage of air into the muffle will cause severe oxidation of the work.

These furnaces probably have a rate of depreciation which is second only to the conventional muffle furnaces, and will require about 5,000,000 to 7,000,000 BTU per ton of iron annealed.

Scale-Free Annealing

For control of temperature throughout the annealing cycle and for producing scale-free work, probably no better periodic annealing furnaces have been built than the electric elevator types. Figure 6 shows a diagram of a two-chamber elevator furnace. The work is loaded on the raised alloy platform of the car and the car is raised into the high-temperature chamber. After the completion of the high-temperature hold the car is lowered and then transferred to the low-temperature chamber. In this chamber the early cooling to 1400 F is accomplished by means of the air cooling tubes shown.

When the amount of iron to be annealed is small, the single batch type furnace has proved quite satisfactory. With this equipment the work is both heated and slow-cooled in the same chamber. The rapid cooling is done either by lowering the load and allowing it to cool outside of the furnace, or by passing air through cooling tubes in the furnace.

Electric furnaces offer a very close control of the annealing process and produce relatively scale-free work even though no generated atmosphere is used. Because of low oxidation loss, the cost for alloy trays and boxes is quite low. The fuel cost for this type of annealing is influenced by the cycle required and the local power cost. Probably the best measure is to say that approximately 275 KW hr per ton are consumed for a 24-hr cycle. History over long periods of operation has shown that this equipment has low maintenance costs and likewise a rate of depreciation not too different from that of other modern annealing furnaces.

Some of the major producers of malleable iron have been using continuous annealing equipment for many years. These furnaces are produced by many manufacturers, but three main types are common and will be mentioned here.

The continuous, gas-fired radiant tube furnaces have found wide favor for annealing malleable iron. They are particularly good for short-cycle iron with not too heavy sections, and in such applications show remarkably low fuel costs.

As with all continuous furnaces, the essential features are the divisions of the furnace. The first zone is one in which the heat input is high so that the work may be brought up to temperature rapidly. The second zone is the holding zone where just enough heat is supplied to maintain the desired temperature. In the third zone the work is cooled rapidly from 1700 to 1400 F by means of cooling tubes. By regulation of the firing in the fourth zone the work can be cooled at any rate that may be desired. An additional zone for further cooling is provided so that the castings can be brought to somewhere near handling temperature before discharge.

Heat-Resistant Alloys Used

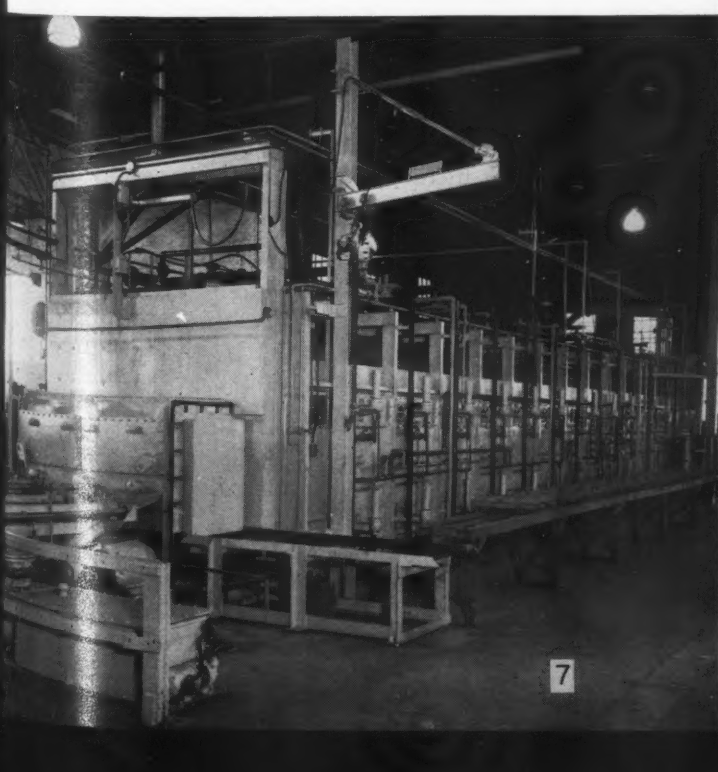
Figure 7 shows the continuous radiant tube furnace. This furnace is of the pusher type, and the trays on which the round containers are loaded can be seen on the return track alongside the furnace. Figure 8 shows a close-up of the vestibule loading device and the trays with containers ready to be pushed into the furnace. This vestibule allows the work to be pushed into the furnace without large amounts of oxidizing atmosphere being admitted. The interior of a large furnace is seen in Fig. 9. The location of the radiant tubes above the work is clearly shown; however, the tubes which run below the pusher rails are not evident in this figure.

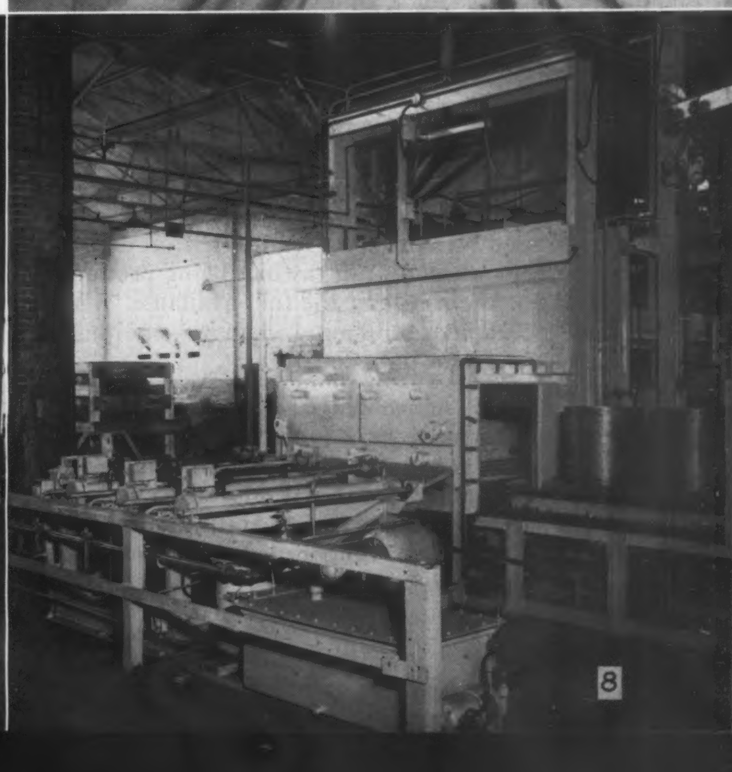
The foregoing figures have indicated that considerable amounts of heat-resisting alloys go into these furnaces, and the initial cost is rather high.

At the same time, the fuel cost is probably the lowest that can be obtained in the annealing of malleable iron. The history of many years of operation has shown that maintenance costs are quite low. These furnaces produce relatively scale-free annealed castings, and improved cleaning results can be expected.

Two types of continuous electric annealing furnaces are being used in the malleable casting industry: 1. The

Fig. 7—Continuous radiant tube. pusher type furnaces. Note trays on which round containers are loaded. Fig. 8—Vestibule. loading device and trays ready to be pushed into furnace. Fig. 9—Interior of large continuous radiant tube furnace. In addition to tubes above the work, tubes also run below the pusher rails. Fig. 10—Charging end of roller hearth type continuous electric annealing furnace. Note water-cooled roller bearings at the conveyor level, and cooling tubes (background) for accelerating cooling rate in the 1700–1400 F range.





roller hearth furnace; 2. the pusher furnace. Figure 10 shows the charging end of the roller hearth furnace. The work is loaded on trays or in baskets which are run into the vestibule at timed intervals. After another definite time has passed, the door to the furnace proper opens and the work rolls into the heating chamber and then moves slowly through the furnace on power-driven alloy rollers. The water-cooled roller bearings can be seen on the furnace at the level of the return roller conveyor, and in the background are the cooling tubes for speeding up cooling in the 1700 to 1400 F range.

Zone Heat Control

The electric pusher type furnace operates much the same as the radiant tube pusher furnaces. Heavy alloy equipment is needed to bear the weight of the castings and the pushing load. If for any reason it is necessary to shut down the furnace, it is necessary to push empty trays in to get the work out. With the roller hearth furnace the loaded trays are automatically rolled out.

As with the radiant tube furnaces, the continuous electric furnaces are divided into zones with individual heat control. Since the furnaces are tightly built, the work provides its own atmosphere to produce scale-free castings, but at the same time auxiliary gas producers are provided to supply an atmosphere if needed for purging the furnace.

In general, both roller and pusher furnaces are rather expensive to install and the fuel cost is likely to be high; however, continuous electric furnaces provide very positive control throughout the process and offer the most easily supervised annealing method available.

The tunnel type kiln has probably been used as a continuous annealing furnace for a longer period than any other continuous type of equipment. Essentially this kiln is a pusher type furnace which is fired either with gas or oil. The hard iron is packed in pots, and these pots are stacked on cars and pushed into the furnace at regular intervals. The rate of travel of the work through the furnace is dependent upon the hard iron analysis and the iron section to be annealed.

This equipment has the advantage of any continuous furnace in that the work can be brought up to temperature quite rapidly, and can also be cooled from 1700 to 1400 F quickly. Control of the cycle is positive.

Installations of this type are expensive, and when tonnage falls off it is sometimes necessary to push empty cars and pots in order to maintain a normal cycle. The pots with this type of equipment have a life similar to those used in the periodic furnaces, but the fuel cost should be markedly lower than with some of the older types of gas- or oil-fired periodic equipment.

Again it should be pointed out that the type of equipment to be used for annealing malleable iron depends a great deal upon the type of castings being produced, the analysis of the iron and the fuel available. These factors should all be kept in mind when new equipment is needed for the annealing department.

Acknowledgment

The author wishes to express his appreciation to the producers of the equipment mentioned in this article for the photographs and information supplied; also, to thank the many people at National Malleable and Steel Castings Co., who have contributed generously from their experience and knowledge.

Popular Ontario Educational Series Includes Molding Practice Classes

Again this year, the Ontario Chapter of A.F.A. is sponsoring a 24-lecture course in foundry practice at F. R. Close Technical School, Hamilton, Ontario. Taught in two sections, the molding class is under Thomas Hewitt on Monday nights and the lecture course is under Willard A. Jones on Thursday nights. Forty-five students are enrolled for the lecture course and twenty of these attend a second night in the week for the molding class. Both instructors are foundry foremen, Canadian Westinghouse Co., Ltd., Hamilton.

The course is under the general direction of R. H. Williams, foundry superintendent, Canadian Westinghouse Co., Ltd., who is Chairman of the Ontario Chapter Educational Committee.

The course consists mainly of a series of technical lectures on the fundamentals of six phases of foundry operation. With slight modification, the lecture course given last year by Mr. Jones is being followed this year.

Part 1, sand control, covers molding and coremaking sands in five lectures. The constitution, properties required, factors affecting properties, and testing methods are discussed. Defects due to sand and recommendations to eliminate them are also covered.

Responsible for the Ontario Chapter 24-lecture educational course initiated in 1946 and expanded in 1947-48 to include molding instruction are (left to right) Thomas Hewitt, molding instructor, Willard A. Jones, lecturer, and R. H. Williams, Ontario Chapter Educational Chairman, all of Canadian Westinghouse Co., Ltd., Hamilton, Ontario.

Five lectures on the metallurgy of the cast iron and non-ferrous alloys include compositions, how and why composition affects structure and physical properties, and the effect of impurities on structures.

In the six lectures on melting, raw materials, fuels, and furnaces are discussed. Descriptions and operations of the furnaces used for melting steel, gray iron, malleable iron and the non-ferrous alloys are given in detail. Theory of furnace operation and methods used in making cast metals are discussed at length.

Various types of pattern equipment, factors affecting pattern construction, and casting design are covered in two lectures. In the fifth phase of the course four lectures are devoted to the various molding methods, machines and tools, and molding terms. The course closes with two lectures on gating and risering.

WISCONSIN CONFERENCE

Capacity Attendance at 11th Annual Meeting Sessions

CAPACITY ATTENDANCE at technical sessions, a registration of nearly 600, and banquet attendance of almost 700, show the 11th Annual Regional Foundry Conference of the Wisconsin Chapter of A.F.A. maintained the standard foundrymen have come to expect of this event. Sponsored jointly by the Chapter and the University of Wisconsin, the Conference was held at the Hotel Schroeder in Milwaukee, February 12 and 13.

Supervision of the Conference was under R. C. Woodward, Bucyrus-Erie Co., chairman, and A. C. Haack, Wisconsin Gray Iron Foundry Co., co-chairman, both of Milwaukee, and associate chairmen, Professor E. R. Shorey and Professor G. J. Barker, of the University of Wisconsin. Ticket sales were in charge of E. C. Meaghar, Chicago Retort & Fire Brick Co.; finances were handled by Chapter Treasurer R. F. Jordan, Sterling Wheelbarrow Co., West Allis, Wis. Walter W. Edens, metallurgist, Badger Brass & Aluminum Foundry Co., Milwaukee, was general program chairman.

The conference was opened, following registration, by Chapter President R. J. Anderson, Belle City Malleable Iron Co., Racine, Wis.; Dean M. O. Withey, college of engineering, University of Wisconsin gave the welcoming address. Time and motion analysis in the foundry was the subject of A. B. Segur, A. B. Segur & Co., whose talk ended the general meeting.

The steel sectional meetings included talks on: "Steel Foundry Sands and Their Relation to Casting Defects" by Professor Howard F. Taylor, Massachusetts Institute of Technology; "The Use of Oxygen in the Open Hearth and Electric Furnace" by George V. Slottman, Air Reduction Sales Co.; a round table discussion on gating and risering led by Professor Taylor; and an authoritative presentation of the subject of hot tearing, by C. W. Briggs, Steel Founders' Society of America.

Sand and cupola operation featured the gray iron meetings, along with a talk entitled "What Do You Know About New Materials and Methods of Production?" by R. G. McElwee, Vanadium Corporation of America, Detroit. Professor W. J. Regan, Pennsylvania State College, spoke on "The Use of Large Sizes of Anthracite in Cupola Operation." "Low and High Temperature Properties of Core and Molding Sand Binders" were discussed by J. A. Gitzen, Delta Oil Products Co. In his talk, "Sand Grain Distribution," Clyde A. Sanders, American Colloid Co., asserted that many casting defects can be predicted by observing the trend of sand grain distribution.

Banquet speaker Congressman Frank B. Keefe (left); Chapter Vice-President R. C. Woodward, Bucyrus-Erie Co., Milwaukee (center); and Chapter President R. J. Anderson, Belle City Malleable Iron Co., Racine, Wis.

At the well attended luncheon are (left to right) J. V. Olle, Motor Castings Co., Milwaukee; Professor Howard F. Taylor, Massachusetts Institute of Technology; and J. A. Gitzen, Delta Oil Products Co., Milwaukee.
(Photos courtesy John Bing, A. P. Green Fire Brick Co., Milwaukee)

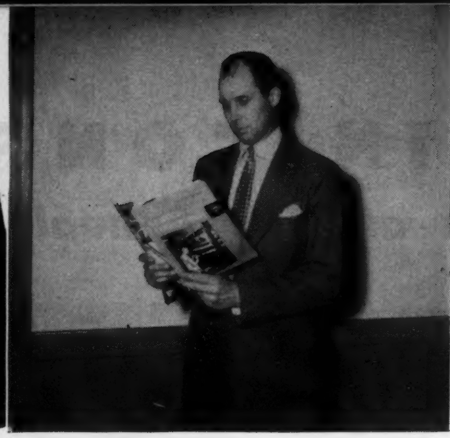
Malleable Sessions Comprehensive

Annealing cycles and furnaces, raw materials, and management problems were covered in the four malleable sessions. C. M. Lewis, Badger Malleable & Mfg. Co., led a discussion on annealing cycles in batch type ovens. The Cole recirculating annealing oven was described by R. N. Cole, Canton Malleable Iron Co., who spoke on design and operation, and by Ray Witschey, A. P. Green Fire Brick Co., who spoke on refractory practice and construction. "1948 Prospects for Raw Materials for Malleable Iron" was the topic of J. A. Claussen of the American Iron & Steel Institute, New York. H. R. Williams, Williams Management Engineering Co., discussed foundry management problems.

Attendants at the non-ferrous meeting heard: Wm. Romanoff, H. Kramer & Co., Chicago, talk on "Proper Selection of Alloys"; J. Kruyne, Marshall & Ilsley Bank, discuss the question, "Are You Going Broke?"; Ray Quadt, Federated Metals Division, American Smelting & Refining Co., Barber, N.J., explained the causes of common defects in aluminum sand and permanent mold castings; and an "information please" panel.

Kenneth Geist, Allis-Chalmers Mfg. Co., spoke on precision casting to a combined pattern and technical

(Concluded on Page 43)



BIRMINGHAM CONFERENCE

Sixteenth Annual Meeting Features International Figures

J. P. McClendon
Publicity Chairman
Birmingham District Chapter

Despite inclement weather during the entire conference the Birmingham District Chapter climaxed its Sixteenth Annual Foundry Practice Conference at a banquet Friday evening, February 13, attended by over 400 foundrymen and guests.

Internationally known speakers directed the program through a 3-day schedule, February 12-14. Dr. James T. MacKenzie, technical director, American Cast Iron Pipe Co., and chapter vice-chairman, arranged the conference program with the able assistance of Charles K. Donoho of the same company. Dr. MacKenzie, an A.F.A. gold medalist, is widely known in metallurgical fields and has represented the United States on committees sent to Europe for a study of foreign practice.

S. T. Jazwinski, chief metallurgist, Barium Steel Corp., New York, and vice-president of the subsidiary Sheffield Iron & Steel Co., Sheffield, Ala., presented an exceptionally interesting paper on "A New Approach to Feeding Castings." The paper described his method of feeding castings, using a gas-producing material in blind risers to develop pressures.

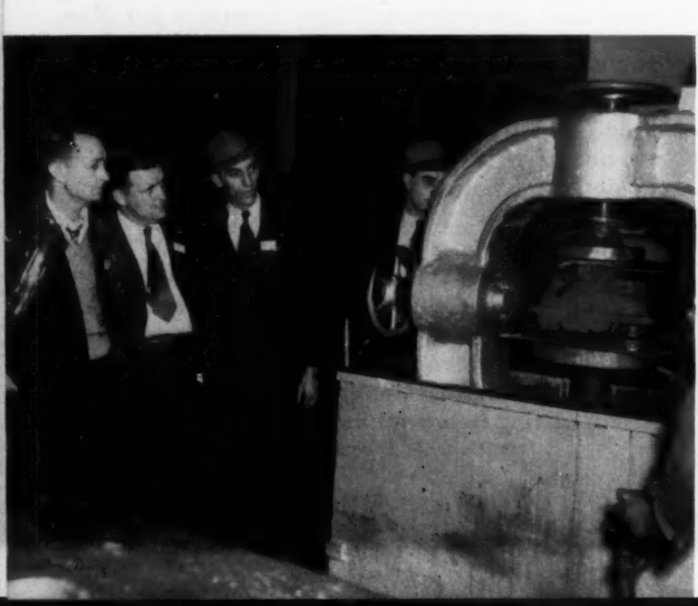
Mr. Jazwinski has been in the United States eighteen months, having escaped to England from his native Poland in 1939. In Europe he was Foundry Manager of the European automobile company, Ursus.

Max Kuniansky, National President of American Foundrymen's Association, was honor guest at the conference and addressed a luncheon meeting, February 12. He described modern foundries as becoming better places to work each year. Machines, he said, have eliminated much manual labor and modern methods have greatly improved working conditions. Wm. W. Maloney, Secretary-Treasurer of A.F.A., accompanied Mr. Kuniansky to Birmingham and was a real inspiration to everyone at the conference.

Gosta Vennerholm, metallurgist, Ford Motor Co., Dearborn, Mich., presented an outstanding paper at

Conference visitors watching hydraulic pressure test of valve body casting at Stockham Pipe Fittings Co. This was one of the many plants visited during the meeting.

(Birmingham Conference photos courtesy John C. Graham, Jr., Stockham Pipe Fittings Co., Birmingham)



Three chairmen who played a prominent part in the success of the conference: (left to right) Membership Chairman D. C. Abbott, Hill & Griffith Co., Birmingham; Plant Visitation Chairman J. T. Gilbert and Registration Chairman A. H. White, both of Stockham Pipe Fittings Co., Birmingham.

←Left—A few minutes after the registration booth officially opened, the Tutwiler Hotel lobby looked like this. Center—Birmingham District Chapter Chairman W. E. Jones, Stockham Pipe Fittings Co., Birmingham, looking over the December issue of AMERICAN FOUNDRYMAN. *Right—A.F.A. National President Max Kuniansky (second from left) talking with a few of the conference speakers. Others are (starting left) Gosta Vennerholm, Ford Motor Co., Dearborn, Mich.; S. T. Jazwinski, Sheffield Iron & Steel Co., Sheffield, Ala.; and Ray F. Frings, Central Foundry Co., Holt, Ala.*

Top—Responsible for the fine entertainment was D. C. McMahen, Harbison-Walker Refractories Co., Birmingham, Entertainment Committee Chairman; J. M. Bates (right), Moore-Handley Hardware Co., Birmingham, was a member of the committee. Bottom—(left to right) Karl Landgrebe, Jr., The Wheland Co., Chattanooga, Tenn.; C. K. Donoho, American Cast Iron Pipe Co., Birmingham; and T. H. Benners, Jr., T. H. Benners & Co., Birmingham, discussing the Sixteenth Annual Conference of the Birmingham District Chapter.

the conference on "Casting Methods in Automotive Manufacture." Many Birmingham foundries are now producing automobile parts and the subject was a timely one.

Mr. Vennerholm spoke of recent technological advances perfected in the Ford foundries which have transformed so-called ordinary iron, "this humble product of the foundry," into one of the most important factors of the automotive industry. The metallurgist cited camshafts as one example, once forged from metal but now being cast quickly and economically under new processes.

He stated that his company once made brake drums for bombers from steel, a product which sometimes had to be replaced after two or three landings. Later, he said, the Ford company perfected a system of casting iron drums centrifugally, thus permitting many times the number of landings possible by a plane.

Automotive Castings

"Gray iron constitutes by far the greatest tonnage used in the automotive industry today," he said, "and well over ten per cent of this country's output of iron is absorbed by the automobile industry." He cited as one example Ford's use of gray iron in the construction of engine blocks. By using such metals as chromium and molybdenum, he said, large castings have been made possible which were unthought of several years ago. Slides and a moving picture illustrated his talk.

J. B. Hayes, J. B. Hayes Co., Birmingham, followed Mr. Vennerholm's talk with a movie entitled "Cylinder Block Cleaning" which brought out several new thoughts and ideas on cleaning processes.

The paper presented by Ray L. Farabee and F. Frings, vice-president and chief metallurgist, respectively, Central Foundry Co., Holt, Ala., entitled "The Centrifugal Casting of Soil Pipe," covered the most recent developments in the production of soil pipe by an entirely new permanent-mold process developed by their company.

One of the important features of the process is the use of a split permanent metal mold which allows manufacture of pipe having protrusions on both ends. This process differs from other centrifugal permanent-mold processes for making cast-iron pipe in that the pipe does not require annealing. The lecture was followed by a 25-minute movie showing the technical aspects.

Special features of the conference included an evening of entertainment when a floor show was presented under the direction of D. C. McMahen, chairman of the Entertainment Committee, and numerous plant visitations under the direction of J. T. Gilbert, assistant to the vice-president, Stockham Pipe Fittings Co., and J. F. Wakeland, plant manager, Alabama Foundry Co., Birmingham. Twenty-eight plants were visited and their actual operations and processes examined by the large group of visitors.

W. E. Jones, chief engineer, Stockham Pipe Fittings Co., and Chairman of the Birmingham District Chapter of A.F.A., presided at the Sixteenth Annual Banquet. He thanked all committee chairmen and members for making the conference one of the best held by the chapter. A token of appreciation for fine work throughout the year was given to Chapter Secretary-Treasurer Fred K. Brown, sales manager, Adams, Rowe & Norman, Inc., Birmingham. A. H. White, chief industrial engineer, Stockham Pipe Fittings Co., chairman of the Conference Registration Committee was commended for the work of his group.

National Director-elect T. H. Benners, Jr., T. H. Benners & Co., a present Director and former Chairman

of the Birmingham District Chapter, was toastmaster. Guest speaker Dr. Albert L. Branscomb, Tuscaloosa, Ala., entertained his audience with many stories illustrative of his subject, "Living On Tiptoe." He urged everyone to live up to expectancy. Truth and scientific development come down the highway of expectancy, he said. A man should stand "on tiptoe" to live life to the fullest extent and to make the most of his abilities, according to Dr. Branscomb.

Gosta Vennerholm paid Birmingham district foundries a compliment in his brief remarks at the banquet. He said he had observed some excellent foundry methods during his visit which he hoped might be put in operation in the Detroit area.

Others at the speakers table were A.F.A. National President Max Kuniansky, Wm. W. Maloney, Secretary-Treasurer of the Association, Dr. James T. MacKenzie, Dr. Ray L. Farabee and Ray F. Frings.

Editor's Note: Two of the papers presented at the Sixteenth Annual Birmingham District Regional Conference—"A New Approach to Feeding Castings" by S. T. Jazwinski, and "Centrifugal Casting of Soil Pipe" by Ray L. Farabee and Ray F. Frings have been scheduled for publication in American Foundryman.

(*Chattanooga Times Photo*)

Chattanooga foundrymen and A.F.A. officials discuss plans for the Chattanooga District Chapter expected to be installed soon. Shown at the February 10 organization meeting, Hotel Patten, are (left to right, seated), A.F.A. National President Max Kuniansky; G. Frank Anderson, Chattanooga Implement & Mfg. Co., Chairman of the Chattanooga Steering Committee; Wm. W. Maloney, Secretary-Treasurer of A.F.A.; (standing) C. E. Saunders, Southern Ferro Alloys Co., and A. D. Willis, U. S. Pipe & Foundry Co., vice-chairman and secretary-treasurer, respectively, of the local group.

Chattanooga Foundrymen Petition For Tennessee Chapter Formation

Approximately 125 enthusiastic foundrymen of the Chattanooga area gathered at the Patten Hotel, Chattanooga the evening of February 10 to consider organization of a new A.F.A. chapter in that area. G. Frank Anderson, Chattanooga Implement and Manufacturing Co., presided as Chairman of the Steering Committee which initiated chapter consideration in November.

National President Max Kuniansky and National Secretary Wm. M. Maloney discussed the organization and operations of the Association, and the advantages of chapter work. President Kuniansky called attention to the increased importance of technology in the industry and the consequent need for foundrymen to keep abreast of the new developments in castings practice and metallurgy which are constantly being made.

"I congratulate you on the opportunity you are making for yourselves," he said, "to learn, to discuss your daily operating and metallurgical problems with your associates, and to benefit your companies and the industry as a whole."

Secretary Maloney traced the development of the Association and emphasized its importance as one of the recognized technical societies of the world.

By unanimous vote, the gathering authorized the Steering Committee to prepare and present to the A.F.A. Board of Directors a petition for a Tennessee Chapter, and approved the Steering Committee acting for the group during the balance of the fiscal year in arranging programs and continuous Chapter activities. Regular nominations and elections of officers and directors will be held prior to June 30.

Seventy-nine Sign Petition

As a result of the meeting, a chapter petition was signed by 79 interested foundrymen and representatives of the area for submission to the Board of Directors. The territory of the Tennessee Chapter is intended to include the entire state of Tennessee east of the Tennessee River.

In addition to Chairman Anderson, the Steering Committee includes the following: *Vice-Chairman,* C. B. Saunders, Southern Ferro Alloys Co.; *Secretary-Treasurer,* A. D. Willis, United States Pipe & Foundry Co.; Porter Warner, Jr., Porter Warner Industries; O. T. Walker, Columbia Iron Works; Fred McGee, manufacturer's agent; Herbert Dent, manufacturer's agent; W. C. Cate, Crane Co.; Karl Landgrebe, The Wheland Co.; P. O. Arnold, United States Pipe & Foundry Co.; and Wm. Greiser, Ross-Meehan Foundries, all of Chattanooga.

Speaker of the evening was G. Vennerholm, Ford Motor Co., Detroit, who described the tremendous workings of the River Rouge Foundry, illustrating the talk with an interesting motion picture.

Guests of honor at the speakers' table included the following: A.F.A. Past-President L. N. Shannon, Stockham Pipe Fittings Co., Birmingham; National Director H. A. Deane, American Brake Shoe Co., New York; A.F.A. Director nominee T. H. Benners, Jr., Birmingham; Chicago Chapter Secretary, V. C. Rowell, Velsicol Corp., Chicago; W. G. Gude, Penton Publishing Co., Cleveland; Gordon Street, The Wheland Co., Chattanooga, and Mr. Vennerholm.

BY-LAWS REVISION SUBMITTED TO ASSOCIATION MEMBERSHIP

A GENERAL REVISION of the Association's By-Laws having been approved by the Board of Directors, the proposed revisions now are being submitted to the Association's membership in accordance with Article XIX of the present By-Laws adopted as of July 1, 1945. Letter ballots have been prepared and shortly will be sent to all members in the United States and Canada, with request that all ballots must be received in the National Office within 30 days following the date of mailing. Tellers appointed by the National President will open and count all ballots and the vote will be announced as soon thereafter as possible in AMERICAN FOUNDRYMAN.

Attention of all A.F.A. members is directed to the accompanying "open letter" to the membership by H. Bornstein, Deere and Co., Moline, Ill., Chairman of the By-Laws Committee which prepared the amendments. Other members of the Committee were: Vice-President W. B. Wallis, Pittsburgh Lectromelt Furnace Co., Pittsburgh; Past-President L. C. Wilson, Reading, Pa.; N. J. Dunbeck, Eastern Clay Products, Inc., Jackson, Ohio; F. W. Shipley, Caterpillar Tractor Co., Peoria, Ill.; J. A. Wotherspoon, J. A. Wotherspoon & Son, Ltd., Oakville, Ont., Canada; D. C. Zuege, Sivyer Steel Casting Co., Milwaukee.

Vote Promptly!

Because of the greatly increased interest in all Association activities, a heavy ballot is expected. It is intended that the new By-Laws, if approved by the membership, will become effective on July 1, 1948.

Open Letter to A.F.A. Members

Gentlemen:

Your By-Laws Committee has met several times since the By-Laws were last revised in 1945. At a meeting in December, 1947, a comprehensive revision was recommended by unanimous vote. The proposed amendments were submitted to the Executive Committee on January 21 and to the Board of Directors on January 22, 1948. The Board of Directors, in accordance with Article XIX of the current By-Laws, has authorized the Secretary to submit the amendments to letter ballot of the membership.

Soon you will receive the proposed amendments together with an explanation of the changes made. You will be asked to vote by letter ballot and will have the choice of (1) voting on all the proposed amendments at one time, and (2) voting on each article as amended.

Please exercise your privilege to vote.

The proposed amendments offer changes in respect to the following important items: (1) Change in name of A.F.A., (2) Classification and definition of membership, (3) Standing committees, (4) Advisory Board, (5) Board of Awards, (6) Technical Committee, (7) Research activities, (8) Chapters.

In most cases the need for the change is quite evident. In some cases amendments are proposed to simplify procedure.

Perhaps the greatest concern of the membership will be in connection with the amendment proposing a change in name from American Foundrymen's Association to American Foundrymen's Society. Every time your By-Laws Committee has met during recent years, the desirability of changing the name has been discussed. It usually was easy to agree that the present name did not properly represent the activities of our organization. The name was not in conformity with the names of other technical societies. This time your Committee decided to make a definite recommendation and your Board of Directors is on record as recommending a change in the name. Your Committee is definitely of the opinion that the change is most desirable.

Again, let me urge you to mark your letter ballot and return it within the prescribed time.

Hyman Bornstein

H. BORNSTEIN, *Chairman*
By-Laws Committee

WISCONSIN

(*Continued from Page 39*)

group meeting. In discussing how a purchasing agent buys patterns, Gilbert L. Hartman, vice-president and general manager, Milwaukee Flush Valve Co., said it is only common sense to consult the foundry before the pattern is constructed. "Unusual Patterns" and a sound film, "Trees for Tomorrow," comprised the Friday morning pattern session. Discussion leaders were H. Wade, Fairbanks-Morse Co., G. Krueger, Allis-Chalmers Mfg. Co., and A. Fischer, Chas. Jurack Co. A. F. Pfeiffer, Allis-Chalmers Mfg. Co., speaking on "Coordinative Function of Pattern Equipment and Castings" completed the cycle of pattern meetings.

Technical sessions not combined with other meetings included talks entitled "Universal Sand Mix for Various Types of Metal," by R. E. Morey, metallurgist, Naval Research Laboratory, Anacostia, Md., and "Use of Statistical Control in the Foundry," by G. R. Gardner, Cleveland Research Division, Aluminum Company of America.

The Thursday evening banquet, always the best attended meeting of the Wisconsin Conference, was addressed by Congressman Frank B. Keefe of Wisconsin, who spoke on "Foreign Relations." Chapter President Anderson presided. "Preparation for the Engineering Process" was the subject of George K. Dreher, Foundry Educational Foundation, Cleveland, who talked at the Friday luncheon meeting.

CUPOLA OPERATION WITH HEATED BLAST

S. W. Healy
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General Motors Corp.
Saginaw, Mich.

A CONCERTED EFFORT is being made by all foundries operating cupolas to obtain the hottest iron commensurate with the most economical ratio of coke to iron. Prior to the war, many automotive gray iron foundries were able to melt iron at temperatures around 2750 F, or higher, with an 8:1, and even a 9:1, iron to coke ratio. In most cases this is no longer possible, and the ratio has dropped to as low as 6:1 and even 5.5:1. This represents a drop in coke efficiency of over 50 per cent, and means a tremendous waste of fuel and money to maintain cupola performance to meet necessary production requirements.

Possibilities of Coke Reduction

Attention can be called to numerous factors, which have a direct bearing on coke savings. These include proper preparation of the coke bed, leveling and distribution of the charge, elimination of sand or dirty material from the cupola charge, and proper air to coke ratio. Other factors include the physical nature of the metal charge and quality of the coke. The latter is one of the major factors in the satisfactory performance of a cupola. Coke properties change from one car to another to such an extent that it is necessary to make drastic changes in the iron to coke ratio.

One of the most neglected factors in coke saving is the use of the hot blast. This method of effecting fuel economy will be discussed in this paper.

Methods of Heating Blast

In general, three methods are used for heating the blast:

1. Indirect heaters using an external fuel for heating the air by means of a heat interchanger.
2. Using the waste gases from the cupola stack as a source of heat. These gases contain carbon monoxide in sufficient quantities when burned with air to generate sufficient heat in a heat interchanger. This method uses both sensible and potential heat of effluent gases.
3. Placing tubes or chambers around the cupola shell between the melting zone and charge floor, the air for combustion being heated as it passes through the tubes. In this method sensible heat of stack gases is used.

The method used to heat the blast is immaterial. The purpose of this paper is to show the advantages of the heated blast and the results being obtained.

Temperature of Hot Blast

Temperature of the blast at the tuyeres runs between 250 and 600 F. Under 250 F little benefit is obtained in fuel savings; however, less difficulty is experienced in bridging and better cupola operation is maintained. As the temperature is increased to around 350 to 400 F,

This paper is the first of a series, dealing with modern cupola operation, sponsored by the Cupola Research Committee of A.F.A. Other papers will appear in future issues of American Foundryman.

cupola operation is much improved and with a considerable fuel saving. On a 16-hr operation, temperatures in excess of 400 F often give lining trouble, and water-cooled glands placed near the shell, back of the melting zone, are necessary. The highest temperature possible, consistent with good operation, should produce maximum fuel economy.

Calculating Coke Savings

The primary purpose in using heated blast in a cupola is to effect some degree of fuel economy. Results obtained on cold blast and hot blast at 375 F with both unscreened and screened by-product coke are shown in Table 1. The screening was carried out by passing the coke over a plate placed at a 30° angle and containing 2-in. diameter holes placed in staggered

TABLE 1—COMPARISON OF HOT BLAST AND COLD BLAST CUPOLA OPERATION

	Unscreened Coke (By-Product)		Screened Coke	
	Cold Blast Operation	Hot Blast Operation	Cold Blast Operation	Hot Blast Operation
Pounds coke required per ton iron melted	317.5 (6.3-1 ratio)	230 (8.7-1 ratio)	287.5 (6.95-1 ratio)	220 (9.1-1 ratio)
Tons per hr maximum melting rate over 3-hr period	22.6	25.3	22.6	26.0
Over 1-hr period	24.0	28.0	24.0	30.0
Average temperature of iron at spout, F	2670	2720	2695	2733
Minimum, F	2630	2680	2655	2700
Maximum, F	2710	2800	2730	2765

positions. The iron was melted in a 102-in. diameter cupola lined down to 72 in. at the bosh. The quantity of air used was 117 cu ft per lb of carbon, plus a 5 per cent loss.

To determine the coke saving on the unscreened coke, using 375 F hot blast, a decrease from a ratio of 6.3:1, to 8.7:1 in coke used can be assumed (Table 1). This amounts to a 27.5 per cent saving.

Using the screened coke figure, the ratio increased from 6.95:1 to 9.1:1. This accounts for a saving of 23.4 per cent. A conservative figure on the coke saving to be obtained with a 375-400 F hot blast will run from 15 to 20 per cent.

Less Oxidation of Charge

Hot blast melting reduces the tendency toward burning out the elements silicon and manganese. This reducing condition necessitates the increase of the steel content in the charge in order to properly control the internal shrinkage characteristics of the iron. It has been found that in the production of iron by the cold blast process, 13 per cent steel in the charge produced a sound casting. When using heated blast at 400 F, internal shrinkage developed in certain castings and the steel content had to be increased to 19 or 20 per cent to entirely eliminate this difficulty. Internal shrinkage is no more difficult to control when using hot blast if the temperature is maintained at a predetermined figure. Substitution of steel for pig iron under normal conditions offers a considerable saving in the cost of charge, but at the present time this is not the case.

The actual amount of heat introduced in the hot blast at temperatures of 375 to 400 F represents only 10 per cent of the total heat developed in the hot gases inside the cupola. The increase in melting rate of about 10 per cent is the result of more efficient combustion of the coke, with a lesser amount of coke being burned per ton of iron melted.

Reference was made regarding shrinkage in castings produced with the heated blast process. The control of both internal and external shrinkage when using hot blast is a matter of maintaining constant blast temperature. The type of equipment will govern this phase of the operation. A blast temperature either higher or lower than that the metal charge calls for is apt to affect the quality of the casting.

Less oxidized metal increases the fluidity of the iron, which reduces the possibilities of misrun castings and favors improved pouring qualities. Due to better combustion conditions at the tuyeres, the tendency toward bridging is lessened, if not almost eliminated. This will allow maintaining more uniform chemical analysis and gives a metal with less occluded gases and entrained oxides and silicates. A slight reduction in sulphur pickup also occurs during melting.

Improved Cupola Operation

Close control of the melting rate, temperature and composition which can be attained with preheated blast is important in the manufacture of high grade castings. When using heated blast, bridging is practically eliminated, which allows the cupola to be operated continuously on high tonnage over a 16-hr period.

Temperature increases run from 20 to 50 F above that obtained from cold blast operation, with hot blast

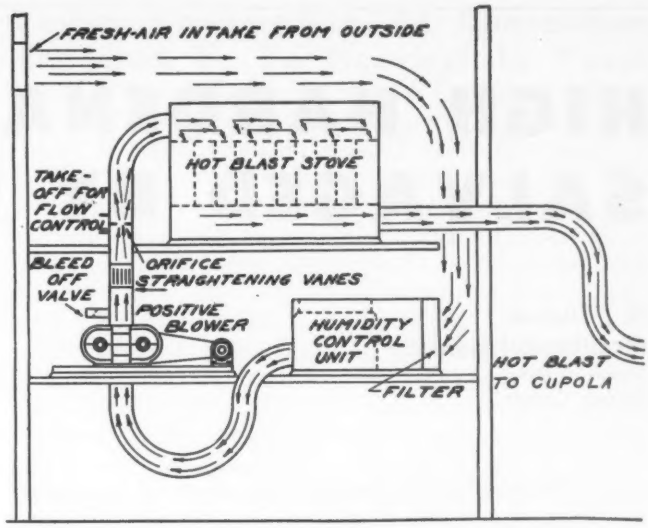

Fig. 1—Schematic diagram of air flow for cupolas.

temperatures of 375 F. This increase in temperature is the result of more complete and better combustion.

Many intangible benefits are to be derived from the use of the hot blast, among which can be listed more uniform composition, less oxidation, elimination of bridging, which gives cleaner tuyeres, better fluidity, lower scrap loss, hotter iron, etc. The tangible items include less oxidation of silicon and manganese, thus reducing pig iron requirements. There is a saving in blower power use due to lower air requirements per ton of iron melted.

Economies of Hot Blast

Gas consumption for hot blast operation at 375-400 F, using the external heater, runs about 170 cu ft of 1000 BTU natural gas per ton of melt. A diagram of this type of equipment, which is in operation in the author's malleable and gray iron foundry, is shown in Fig. 1.

The hot blast operated cupola has a more concentrated burning-in at the melting zone. The refractories burn deeper, but not over as wide an area. This results in a somewhat higher refractory cost. Quite often, where a cupola operates over a 16-hr period, it is necessary to install water-cooling glands to increase the life of the refractories.

The cupola is the oldest and most economical melting medium. By the use of the hot blast, the thermal efficiency of the cupola can be increased from 37 to 55 per cent. The superior iron of today has been developed through scientific thought and careful attention to the melting practice.

Graphite Chart Available Again

Available again in limited quantity, the A.F.A.-A.S.T.M. Graphite Flake Classification Chart with descriptive matter is for sale at A.F.A. headquarters at 25 cents per copy to Association members.

The descriptive matter explains the procedure for grading graphite flakes according to eight sizes and five types recognized as standard by A.F.A. and the American Society for Testing Materials. Flake sizes and types are illustrated by reproductions of photomicrographs at 100 diameters and by drawings.

HIGH HARDENABILITY STEELS SALVAGED BY WELDING

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World War II has now been over for more than two years and technical publications frequently report developments of the "now it can be told" type. To some extent this paper is of that nature, and should be of particular interest to foundries casting the higher hardenability steels. Frequently considerable savings can be effected by the intelligent use of welding as a means of salvaging defective or cracked castings. Present-day competitive conditions make it desirable for foundry management to make use of every opportunity to reduce costs, and welding can be expected to play an ever-increasing role in foundry operation.

During the war a Canadian foundry was casting steel shoes (Fig. 1) for the M24 Cadillac tank and shipping them to an American prime contractor for machining and subsequent assembly into the vehicle. The shoes with which difficulty was encountered were of the following air-hardening composition, which was higher in carbon content than the normal (0.35–0.42 per cent) analysis:

Component	*Per Cent*
Carbon	0.45–0.53
Phosphorus	0.05 max.
Sulphur	0.05 max.
Manganese	1.30–1.55
Silicon	0.35–0.60
Chromium	0.45–0.60
Molybdenum	0.35–0.45

After casting and shakeout the risers at the end lugs were flame-cut away and the lug face ground. The castings were then normalized and drawn to a hardness of 217–269 Brinell. This manufacturing procedure progressed smoothly until, in an effort to speed up the lug-grinding operation, a different type of grinding wheel was used. The result was overheating of the steel and a self-quench producing a maze of grinding cracks (Fig. 2). The rate of production was such that the cracks were not detected until approximately 20,000 shoes had been produced, some cracked on one lug and some on both. A corrective change of grinding procedure was made and the difficulty eliminated.

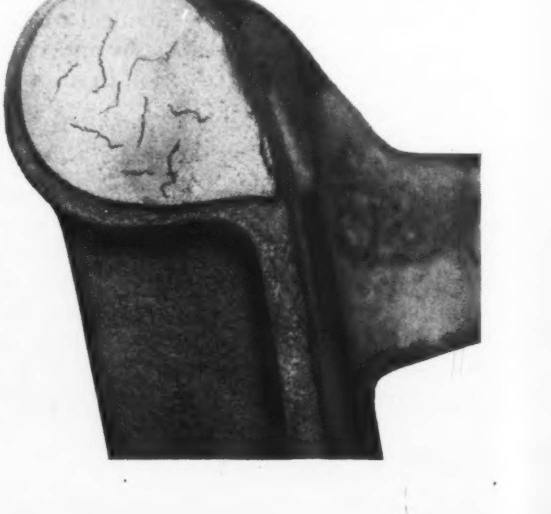
Selecting Salvage Method

The question immediately arose as to the economic feasibility of salvaging the castings. Two methods of welding repair were tested. One method consisted of melting down and fusing the cracks with an oxy-acetylene torch and then adding sufficient material to permit a re-grinding clean up . This method had the advantage of relatively slow heating and cooling but had two marked disadvantages, namely, (1) two great a dependence upon the skill of the welding operator to completely eliminate all cracks, and (2) the method was too slow to be economical. Hardness testing after redrawing at 1225 F, revealed that both welds and heat-affected zones were within the hardness range of 217–269 Brinell.

The second method, which was ultimately used, consisted of flame cutting the cracked material away, using the heat so generated as a preheat, and welding the lug by the metallic arc process. As shown by the composition previously mentioned, the material could not be considered as readily weldable. However, the projection of the lug away from the main body of the casting made local preheating possible and allowed slow cooling at the completion of the welding. The electrode used was the then recently developed NRC 2A type,

Fig. 2 (right)—Close-up of face of end lug. Inked lines represent maze type of grinding cracks occurring on lug. Actual size.

Fig. 1—General shape of track shoe castings. ×¼.



which generates an arc atmosphere low in hydrogen content. The development of this electrode was the direct result of welding research which revealed that ordinary arc welding electrodes generated considerable volumes of hydrogen, and that when these were used to weld air-hardening steels considerable underbead cracking resulted. The new type of electrode was free from this difficulty when used with moderate preheating temperatures. Experiments on the shoes revealed that crack-free welds were consistently produced, and that after drawing at 1225 F for one hour both the welds and the heat-affected zones were within the specified hardness range.

The welding technique developed after considerable experiment consisted of using a $\frac{1}{4}$-in. diameter electrode, striking the arc at the center of the lug and building up to the required height, and then moving the arc in a slow outward spiral until the edge was reached. Heavy hinged copper retaining rings were clamped around the outside of the lug to prevent overflow of the liquid metal. The main difficulty in developing the technique was porosity of welds due to the operator's tendency to attempt to reach the outside edge of the lug too rapidly. It was found that the arc speed that was sufficiently slow to allow proper build-up was slow enough to allow occluded gases to escape, and consequently porosity was eliminated.

A production set-up for salvaging the shoes was then organized. It consisted of buffing the lugs, inspection for crack detection, flame cutting, welding, grinding to the required tolerances, drawing and final inspection. Where a shoe was cracked on both lugs the process was interrupted after welding and the shoe was returned to flame cutting for preparation for the second weld. Such a procedure was possible in that experiments had shown that air cooling after welding was sufficiently slow to avoid cracking of the base material.

Testing for Machinability

Drilling and broaching operations on the end lugs required good machinability. Some doubts were held as to the machinability of welds and heat-affected zones. To assess the effect of welding on machinability, 500 shoes were salvaged by the foregoing procedure and fed into the high speed machining production line. Each shoe in this test lot was examined carefully, and tool wear checked during the various operations. No machining difficulties were encountered, the operations proceeding equally well as with unsalvaged shoes.

As a final inspection operation, the end lugs were brass plated to detect cracks. This test is based on the fact that the brass will not plate across a crack. As a result all cracks show up as black lines through the plating. Of approximately 20,000 shoes salvaged, a total of 644, or 3.22 per cent, were rejected on the final crack inspection.

The average cost of salvage was 50c per shoe, and when this is compared with a manufacturing cost of \$4.50 per shoe it is apparent that the salvage was economically justified. It is quite true that all defective castings may not lend themselves so readily to a sequence of operations such as were used in this case. It is, however, an example of the economies possible if alert foundry management realizes the advanced status of present-day welding.

Ladies Registration At Convention Expected To Be Heaviest In Years

Ladies registration at the 52nd A.F.A. Annual Meeting and Foundry Show will be heaviest in years according to the trend indicated by hotel reservation requests. Ladies' Credential Cards to identify wives of A.F.A. members will be mailed to all members about April 1.

Plans for the ladies have been announced by H. J. Williams, New Jersey Silica Sand Co., chairman, and Mrs. Williams, co-chairman, of the Philadelphia Chapter Ladies' Entertainment Committee.

The program starts Tuesday, May 4, following registration on Monday, with a reception and tea staged with the compliments of the American Foundrymen's Association. Held at the John Wanamaker store, these events will be followed by a fashion show.

Scheduled for Wednesday morning is an escorted motor tour to historic shrines such as Independence Hall, the Betsy Ross House, Elfreth's Alley and other spots closely associated with the early history of the United States. Wednesday afternoon will be taken up with visits to the Franklin Institute where "science is fun" and the Fels Planetarium.

Historic Valley Forge, headquarters of the Continental Army from December 18, 1777, to June 19, 1778, will be visited on Thursday. The week will end with the Annual Banquet on Friday, May 7, at the Bellevue-Stratford Hotel.

Mail Convention Preprints April 1

Convention preprint request forms should be marked and returned to Association headquarters as soon as possible. Requests not received at A.F.A. headquarters by March 25 will not be filled prior to the Convention. The list of 1948 Convention preprints and request forms were mailed to A.F.A. members on March 1.

Mailing of preprints will start April 1. Members are requested to bring their preprints to Philadelphia; preprints will not be distributed at the Convention.

Six Convention papers will appear in the April issue of AMERICAN FOUNDRYMAN. These will not be preprinted separately.

Written discussion of Philadelphia Convention papers should be sent to S. C. Massari, Technical Director, American Foundrymen's Association, 222 W. Adams St., Chicago 6, Ill.

Hold Industrial Hygiene Conference

A conference on industrial physiology and human engineering, sponsored by the Industrial Hygiene Foundation of America, will be held March 23 at Mellon Institute, Pittsburgh, Pa., with the objective of exploring the application of "human engineering" and related subjects to the field of industrial design.

Key representatives from research institutions and industry have been invited to attend. A.F.A. expects to be represented by Technical Director S. C. Massari. While the scope of this initial conference will be rather broad and exploratory in nature, it is hoped that this and later conferences will develop information on the capabilities and limitations of workers in production which may have a pronounced effect on future engineering design.

ECONOMICS OF CASTINGS USE

Everett Laitala
Associate Professor of Mechanical Engineering
University of Illinois
Urbana

The purpose of the paper is to consider those factors which indicate when castings are most economical to use, not to indicate that castings should always be used. The pattern evolved for evaluating the economics of castings can be adapted to evaluating any of the production processes. This paper is expected to be helpful to instructors in foundry practice, machine design and industrial engineering.

"Lost-wax casting is an ingenious adaptation of a centuries-old method to modern industrial needs. The same process used by medieval artists in producing metal statuary is now employed in the casting of gas-turbine and supercharger blades, switchgear components, dies, tools, and a wide variety of other metal parts. It has two outstanding advantages. Parts characterized by complex shapes or curves can be reproduced in fine detail and excellent surface condition. More important, highly desirable alloys that are too hard to be machined or forged can be cast with precision."*

Packed into this interesting paragraph are some secrets to the economics of the casting process. It is not because of our love for the past and a centuries-old method that we turn to castings to satisfy many of our product needs. What is there then, in castings and in the casting process, that makes for continuity of their use throughout the centuries and in meeting modern industrial needs?

It is not an accident that castings enter directly or affect indirectly almost every manufactured product. There must be some fundamental reasons for persistence and growth in the use of castings and of the casting process. It is the purpose of this paper to look into the basic economic aspects of this process.

Must Sell Product

To analyze the economics of castings use, let us establish first those factors which form the objectives of a business if it is to be successful or to become more successful. A successful business, it may be said, is one which brings a fair return to the investor, pays good wages and salaries, and provides good working conditions. Needless to say, a business to be successful must sell its product. This implies that it is the consumer who determines the success or failure of a business by his willingness or unwillingness to purchase the product. If this is true, what must be done by a business to make the consumer willing to buy the product?

Two things it seems must be done:

1. It must produce a product which satisfies to the best advantage the many interests of the consumer.
2. It must make contact with potential consumers to let them know that the product does exist and to indicate how it can meet their many interests and needs. In short, the product must be sold.

How do these general considerations which are applicable to any product relate to the economics of castings use? In the first place, the definition of the term economics indicates that we should not only be concerned with the conditions and laws affecting the production of castings, but with the distribution and consumption of them as well. While this paper will be concerned principally with the factors affecting the design and production of castings, it must be emphasized that a product which potentially might satisfy a consumer's needs in an excellent manner would contribute nothing to the success of the company unless the product were brought to the attention of the potential consumer for his consideration.

What has the foundry industry done from this latter viewpoint? What is it doing? What is it going to do? Is there a need for a sales department in each foundry organization? Is there a need for a sales engineer who can read potential consumer's drawings and assist in determining whether a casting would permit satisfaction of more demands and interests than the use of competitive production processes? Or, is the foundry going to wait for a potential consumer to decide on his own (very often meager) knowledge that a casting might best satisfy his needs?

Exploring Potential Market

Many more questions relative to the extent to which foundries have explored their potential market and the kind of selling job they have done to cut into that market might be asked. How these many questions might be answered by individual foundries surely should vary from very favorable answers to extremely unsatisfactory ones. The writer is inclined to believe on the basis of his industrial experience that in general individual foundries have not entered into the sales field with vigor, and that they wait for the consumer to come to them.

In the way of summary then, it must be emphasized that the economics of castings use is not only dependent on production of a good and economical casting, but on letting potential consumers know that it exists.

Assuming that we are prepared to do a good sales job and a good job in finding out who could use castings, the next consideration is one of providing a casting which will meet the consumer's many needs to the best advantage. What factors in the end use of the product must be considered in satisfying these needs?

* *Westinghouse Engineer*, p. 180, Nov., 1946.

Note: Presented at the 55th Annual Meeting, American Society for Engineering Education, at Minneapolis, June 20, 1947.

The influencing factors would seem to be as follows:

A. Function
B. High quality
C. Minimum cost
D. Delivery of product when needed
E. Eye appeal

Before discussing each of these factors it is well to point out here, as will be emphasized later, that a product, whether it be produced by casting or by other processes, to assume a favorable competitive position, depends upon how well these five factors have been incorporated in the product.

Foundries like other businesses are prone to place quality as the all-important factor. History provides us with many examples where the company went out of business because it made "too good a product." We could take a year to turn out a really high-quality casting, but what good would it be to a customer who needs it next week? Likewise, if the cost of the casting is beyond the customer's ability to pay for it, or is more than he thinks it is worth to him, he will not take it. Let us examine each of these five factors briefly.

A. Function—The designer of a product has as a first responsibility the production of a design which will do the job for which it is intended. The Wright brothers, for example, in designing their first airplane were concerned with getting something which would fly. How long it would stand up in service or how efficiently it would operate were of secondary importance. To design many products the designer often finds that he needs an intricate design to accomplish his objective. It is here that the casting process often provides the means to satisfy the designer since castings can be produced in an almost unlimited variety of shapes and sizes. Within practical limitations some designs are almost unproducible by other means.

B. High quality—If it is assumed that a designer has produced a product which will perform the function or job, then the next desire is that the product stand up well in service and operate efficiently. In short, the consumer is looking for high quality in the product he buys. What are some of the properties that affect dependability and life of products. They are: strength, rigidity, weight, resistance to corrosion, hardness, surface condition, etc. These demands can be met by the tremendous flexibility that the casting method permits. First, a change can be made from one metal to another since most metals can be cast. Second, the use of castings permits resort to a great number of alloys. Third, the casting method permits an almost unrestricted changing of structural shape. And fourth, the casting process itself can be changed to give variations in the final properties of the product; for example, chilling the surface of a gray iron casting to produce hardness.

In what way does the casting method contribute to greater operating efficiency of the product? Because the casting method places very few limitations on the intricacy and contour of a product design, it permits the designer to use smooth lines and flowing contours where gases, liquids and other materials must be conveyed by or in the product. There are many applications of castings, such as oilless bearings, which also indicate castings contributions to operating efficiency.

C. Minimum cost—"Dat ole debbil, cost" is the answer which *Fortune* magazine, in its February 1947 issue, gave to the question, "What Happened to the Dream World?" The dream world that *Fortune* had reference to was "that thermoplastic, aerodynamic, supersonic, electronic, gagetonic world that admen promised during the war." In short, a product which is sound from a functional standpoint, and which is of high quality, is not a product which contributes to the success of a company unless it can be produced at a price which the user can afford or is willing to pay.

Let us first go through a short course in cost accounting in order to establish a common basis for arriving at the ultimate manufacturing cost of a product. Let it be assumed that we operate a foundry and that our interest is to determine the cost of making a casting. The cost elements are as follows:

Direct material cost—This includes all materials which can be measured and associated directly with the order for castings.

Direct labor cost—This includes (a) all productive labor which can be measured, as with a time card, and associated directly with the order for castings, and (b) set-up labor, prorated over pieces run per set-up.

Indirect charges, overhead—Supervision, lights, heat, power, taxes, insurance, depreciation, office salaries, supplies, etc.

Manufacturing cost—Sum of elements 1, 2, 3.

Special tools or pattern costs—Prorated over desired volume of production.

It should be noted that the foregoing concerns only the cost of making the casting, and that selling cost and profit are not considered. If actual cost figures are used, the cost of the casting may look like this:

Direct Material	Direct Labor	Overhead	Manufacturing Cost	Tool or Pattern Cost
\$0.06	(a) \$0.10 (b) Set-up	\$0.20	\$0.36	\$180.00

This is an all-important relationship of the elements of manufacturing cost. Herein lies the only approach to determining the economics of one material over another, one method over another, and one design of product over another. In the foregoing example, the unit manufacturing cost of the casting is \$0.36, and the total cost of the pattern necessary to permit turning out the item at \$0.36 is \$180.00.

What is the total unit cost of the item including the pattern cost? It can be seen that no answer to this question can be given until it is known how many units are to be made over which the pattern cost is to be spread. If the total number to be made is 1000 units, the total cost is \$0.54 (\$0.36 plus \$180 ÷ 1000). If, however, 2000 units are to be made the cost would be \$0.45.

It should be observed here that, for any given method of production, as established by the tooling and equipment provided, the ultimate manufacturing cost is conditioned by the volume of units to be made. Also that the ultimate cost for a given volume of production may be changed by spending more or less money in the individual cost elements. This could be accomplished, for example, by providing more expensive tooling to reduce direct labor cost. Or, a change may be made from one material to a more expensive material which can

be processed faster, thereby permitting a lower labor cost. Or, a change may be made from a more expensive material to a less expensive one to reduce the material cost, but which might increase the labor cost.

The criterion as to what material ought to be used or how much should be spent for tooling is the ultimate cost, as determined from a summation of the individual cost elements: material cost, labor cost, overhead cost, and tooling cost. To discuss any alternative methods or materials in terms of only one of the cost elements is utter folly unless some special conditions allow for giving more consideration to one than the others.

Let us consider the foregoing cost principles in terms of the economics of castings use. What is there inherently in the castings process which makes for production of a product at a minimum ultimate cost under certain conditions? It is not possible, unfortunately, to state a single set of conditions under which the casting process will always assume a leading position over other manufacturing processes regardless of the product being considered.

Since most castings must be machined, it is necessary to keep in mind not only the cost of the casting as it comes from the foundry, but also the labor, overhead, and tooling costs which may be necessary to finish the raw casting. One conclusion can be stated here without further discussion; namely, that it is not possible to determine which manufacturing process will give the least ultimate cost to the product without knowing exactly what the product design calls for, the number of units to be made, the date when product is needed, and the rate at which design changes occur. As has been pointed out, the cost of making an item by an alternative process should be determined on the basis of an analysis of all the cost elements relative to each other and not independently of each other.

Cost Factors

It is, therefore, very difficult to single out the factors which under certain conditions make the casting process inherently the low cost production method. Perhaps the only way is to try to indicate what these factors might be by selecting certain conditions where castings assume a favorable position.

1. There are product designs which would require removal of much metal were a casting not used. A casting, therefore, may permit reduced labor and material costs.

2. The casting method may minimize machining costs where designs are complex. Shape or form which might be effected by other methods might be incorporated in a casting at lowest cost.

3. The casting method permits low cost utilization of highly desirable alloys which have too great a hardness to shape by other production methods. This permits reduction in original cost of product as well as in operation of the product because of greater life.

4. The casting process permits altering properties of metals at low cost by a change in casting method. For example, a hard abrasion- and corrosion-resistant surface not requiring machining might be obtained by chilling gray iron.

5. The ease with which pattern materials can be worked in contrast to metals necessary for tooling up for other production methods is a definite cost advantage, dependent, of course, on volume, design of product, date when product is needed, and rate at which design changes in the product may occur.

6. Set-up costs are generally very low in a foundry. Changing from one product to another calls for a minimum amount of preparation. A change of pattern and flask size may be the only time-consuming elements.

7. Saving in assembly labor can result from the use of a casting. The work of assembling separate parts might often be eliminated or minimized by an integral casting. The overall cost may be less if the patternmaker takes the time to combine the separate parts into a single pattern rather than to make the separate parts by other production processes and to have the production assembler spend too much time per unit to get the parts together.

Here again it must be emphasized that no generalizations can be made. We may, for example, have need to produce only one item consisting of several parts. By use of a fabricating process these parts might be put together with much less cost than the pattern cost itself. On the other hand, the design might be such as to permit a big saving by use of a casting.

Indirect Savings

8. Savings other than in direct material and direct labor can often be effected by use of castings. Consider a few key overhead costs from the viewpoint of the user of castings.

(*a*) *Operation Sheets*—The process engineer must route the product through the shop by establishing a so-called operation sheet which indicates where and how operations are to be performed. The time required to do this would be dependent upon the complexity of design of the product and the production processes used. If the product consists of many individual parts, the job of establishing the operations for each becomes time consuming and costly. If, on the other hand, a single integral casting is provided, much of the time of the process engineer is saved in that many of the details are incorporated in the pattern.

(*b*) *Production Standards*—The cost of establishing production standards from individual time studies or standard data would be in proportion to the number of operations required by the product. Since many of the operations required by a fabricating process are incorporated in the pattern originally, the casting process would effect a saving in this overhead cost item.

(*c*) *Production Control*—The problems of regulating the flow of work through a shop is in proportion to the number of parts manufactured. It is quite obvious that reducing the number of parts would also reduce the overhead cost. A casting would stand in good favor here, also.

(*d*) *Storage of Materials*—The same reasoning as mentioned immediately above applies to stockroom operation and records.

(*e*) *Inspection*—The number of inspection operations necessary would generally vary with the number of individual parts to be made. Should these be reduced in number, inspection costs could most likely be expected to decrease.

D. Delivery of Product When Needed—This factor in the measuring device, alongside function, quality,

and minimum cost, is a rather harmless-looking unit, but a little thought relative to it will bring out an importance that gives it a place of order which at times is even higher than cost or quality. During the war years the primary factors for consideration were that the product perform its function properly, be of high quality, and that it be obtainable in the shortest period of time. Cost in the war emergency was a secondary consideration. The postwar years have witnessed a phenomenon in which consumers were willing to sacrifice quality and pay higher prices in order to get the item immediately. Also noted, since many needs have been sufficiently well satisfied, has been a slowdown in purchasing because quality and cost were out of line. However, in a normal competitive market the successful business must provide a product which performs the function desired by the consumer.

Castings play an important part in satisfying the demand for good customer service. Getting into production in the foundry is a matter measured in terms of days, where by other methods of processing it is a question of weeks. The making of a pattern, because of the materials used and the fact that most of the patternmaking generally follows directly from the part drawing, permits the foundry to get into production at an early date in contrast to other production methods involving considerable tool designing and a lengthy toolmaking process.

It must be pointed out again that volume is a conditioning factor. As in the matter of costs, an overall study is necessary. It is not only a question of how soon the unit can be put into production, but also one of rate of output when in production. As far as volume of units to be made is concerned, the casting process would be the more favorable when smaller quantities are involved if the parts are of such size as to be made in presses. If the parts are of such size and design as to make a fabricating process a competitor of the casting process, then the latter may be most favorable covering the whole range of volume, depending entirely, of course, upon the specific nature of the item and the amount of tooling-up time necessary in each case.

Where shorter runs are involved and minor design changes occur often, castings assume a very favored position from the standpoint of fulfilling the desire for earliest delivery date.

E. Eye Appeal—In what way does the casting process assist the designer in satisfying the eye-appeal factor in design? By its inherent nature the casting process provides the designer with a means of giving his product smooth, flowing lines and contours so much desired by a people conditioned to streamlining. Because of the flexibility of the process it is not necessary to alter the functional design to get the desired appearance.

Summary

The economics of castings, like that of products produced by other methods, must be evaluated in terms of the soundness of the sales program and in terms of the soundness of the product to be sold. The soundness of any product must be evaluated in terms of five factors; namely, function to be performed, quality, eye appeal, cost, and time of delivery. It has been the purpose of this paper to consider, in the light of these factors, some of the conditions under which the casting process might assume the most favored position.

Combat Shortage and High Cost Through In-Plant Scrap Drive

In an effort to combat scarcity and high cost of scrap, American Brake Shoe Company is beginning an extensive drive to collect scrap iron and steel among its 60 plants and 10,000 employees according to Wm. B. Given, Jr., president. Purpose of the drive is to get every pound of usable metal out of company plants and neighborhoods and into steel and foundry furnaces as soon as possible.

A preliminary test drive which was recently conducted in two plants of the company revealed 200 tons of usable scrap metal. The company-wide drive will concentrate on finding such scrap items as obsolete dies, machinery and equipment; wheels and gears; worn-out shovels, wheel barrows and hand tools; old flasks and tote boxes; and pieces of rail.

Inter-plant publicity used in the scrap collection drive shows how the two plants, known for good housekeeping, found scrap valued at $8,000.

Urging employees to look in every bin, dark corner, back yard and cubby-hole, American Brake Shoe suggests looking for the following types of scrap: obsolete machines, old wheels and gears, obsolete dies, old pipe and conduit, old flasks and tote boxes, odd pieces of rail, worn out shovels and wheel barrows, old tanks, barrels, and buckets, worn out hand tools, and cutoffs in machine shops from bar stock, etc.

Reduce GI Training Overpayments

Overpayments of subsistence to veterans who terminate training under PL 346, the GI bill, can be reduced to a minimum, according to a recent bulletin from the Veterans Administration.

Employers are requested to send notice of interruption of training to the nearest Veterans Administration immediately. Notice can be sent on VA Form 1908 or on company stationery.

German War-Time Foundry Reports Being Sold By Commerce Department

Metal casting, especially as practiced in Germany during the war years, is comprehensively covered in 12 reports now on sale by the Office of Technical Services, Department of Commerce. Prepared by American and British industrial intelligence specialists and a German consulting engineer, the reports total 492 mimeographed pages of information on steel, aluminum, brass, and bronze foundry practices.

Subjects covered include centrifugal casting, casting aluminum and aluminum alloy billets, continuous casting, ingot molds for steel ingots, and an extensive report on the German steel castings industry.

Other reports cover mold and core washes, casting of nickel anodes, melting and casting of nickel silver alloys, and the production of dense, non-porous bronze castings. The latter report gives 25 rules for reducing porosity and blow holes in bronze castings.

Requests for additional information and orders should be addressed to the Office of Technical Services, Department of Commerce, Washington 25, D.C.

SULPHUR DETERMINATION

Volumetric Method for Copper-Base Alloys

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OF LATE, sulphur contamination in brass and bronze is commonly encountered by both the smelter and foundryman due to the high sulphur content of the fuel available. To follow the sulphur refining process in the furnace, this laboratory felt the need of a method for sulphur which should be rapid, accurate and simple.

The methods commonly available for the determination of sulphur are the gravimetric,[1] combustion,[2] and the volumetric tetrahydroxyquinone [3] methods. The difficulties associated with obtaining an accurate sulphur determination by the barium sulphate method are well known.[1] For the small amounts of sulphur in copper-base alloys a number of hours are needed for a determination, and great care must be exercised in order to obtain accurate results. The combustion method, although meeting the requirements of speed and accuracy, still needs bulky special equipment, and is best suited for conditions where a great number of sulphur determinations are to be run daily. The tetrahydroxyquinone volumetric method, although suitable for a number of special purposes, still is difficult to carry out where small amounts of sulphur are concerned. It was found that for application in copper-base alloys the difficulty of removing interfering elements was so great that further work was dropped.

C. L. Luke [4, 5] has proposed a volumetric determination of sulphur in rubber based on a method by St. Lorant [6, 7] as applied to biological materials. Application of this method to copper-base alloys showed it to be rapid, simple and equal in accuracy to the best available umpire methods. The sample is dissolved in a mixture of hydrochloric and nitric acids and bromine.

After taking to fumes with perchloric acid, the sulphuric acid is reduced with a mixture of hydriodic and hypophosphorus acid to hydrogen sulphide. The hydrogen sulphide is distilled into an ammoniacal cadmium chloride solution and then titrated with potassium iodate. A run is easily completed in less than 20 min and, using a one-gram sample, the results are within plus or minus 0.002 per cent of the true sulphur content. The disadvantage of the high cost of the materials is more than offset by the time gained and the accuracy realized.

Hydrochloric-Bromine Mix—A saturated solution of bromine in hydrochloric acid.

Hydriodic Acid Mix—Into a 500-ml flask transfer 160 ml hydriodic acid, 160 ml hydrochloric acid and 40 ml hypophosphorus acid. Add a few glass beads, raise to a boil and boil briskly for 5 min. Cool to room temperature and transfer to a dark glass-stoppered bottle. The purpose in the boiling is to volatilize any sulphur present in the reagents.

Cadmium Chloride Solution—Dissolve 20 g cadmium chloride in water, add 600 ml ammonium hydroxide and dilute to a liter with water.

Standard Sodium Thiosulphate—Dissolve 3.1000 g of the pentahydrate in water. Add about 0.2 grams of sodium carbonate and dilute to exactly 2 liters.

Standard Potassium Iodate—Dissolve 0.4450 g potassium iodate, 2 g sodium hydroxide and 10 g potassium iodide in water, and dilute with water to exactly 2 liters. One ml of this solution is equivalent to 0.01 per cent sulphur on a 1 g sample. To determine the strength of the thiosulphate in terms of the iodate, transfer exactly 15.00 ml standard potassium iodate to a 250 ml Erlenmeyer flask. Add 125 ml water and 15 ml cadmium chloride solution. Cool somewhat in running water and add 20 ml concentrated hydrochloric acid. Add about 0.2 g potassium iodide, 5 ml starch solution and titrate with the thiosulphate to a colorless point. Divide the ml iodate by the ml thiosulphate to obtain the potassium iodate factor. The thiosulphate will gradually lose strength and should be restandardized once a week.

Starch Solution—Triturate 3 g starch with a little cold water and add to 500 ml boiling water. Continue

TABLE 1—DETERMINATION OF SULPHUR IN VARIOUS COPPER-BASE ALLOYS BY VOLUMETRIC METHOD

Alloy	Sulphur Present, per cent	Sulphur Found, per cent	Error, per cent
US BS 63a	0.11	0.112	0.002
		0.110	0.000
		0.112	0.002
US BS 124b	0.041	0.041	0.000
		0.041	0.000
		0.039	0.002
80-10-10 *	0.023	0.025	0.002
		0.021	0.002
		0.024	0.001
Ni-Ag *	0.124	0.122	0.002
		0.123	0.001
		0.123	0.001

* Sulphur result on average of four determinations by gravimetric $BaSO_4$ method.

to boil until clear. Cool, add 2-3 ml chloroform and keep in glass stoppered bottle. If the solution becomes cloudy, discard and make a fresh one.

Distilling Apparatus—A 275 ml Johnson's sulphur flask fitted with a two-holed No. 6 stopper. Through one hole a thistle tube is inserted, and through the other hole a bent tube. This setup has proven very satisfactory for sulphur runs and it has not been found necessary to use an all-glass apparatus.

Procedure

1. Transfer one gram borings to a Johnson's flask and add 20 ml hydrochloric acid bromine mix and 10 ml concentrated nitric acid.
2. Heat until action starts and let stand over a moderate heat until the sample is in solution. Add 5 ml 60 per cent perchloric.
3. Take down to strong perchloric fumes and continue until the acid refluxes down the walls of the flask.
4. Let stand about one minute and cool in running water to room temperature.
5. Add 35 ml hydriodic acid mix and immediately cap with the stopper containing the thistle tube and side arm. Be sure that the bottom of the thistle tube extends into the acid.
6. Set the side arm into a 250 ml Erlenmeyer flask containing 15 ml cadmium chloride solution and 125 ml water. The receiving flask should set in a large beaker containing cold water.
7. Distill at such a rate that the solution is kept at a brisk boil. Continue the distillation for 5 min from the time white fumes first appear in the receiving flask.
8. Lower the receiving flask while washing down the side arm and cool in running water for about 2 min.
9. Add about 0.2 g potassium iodide, 20 ml concentrated hydrochloric acid, swirl to mix and titrate with a standard potassium iodate until the solution assumes a definite yellow color.
10. Add 5 ml starch solution and titrate with standard sodium thiosulphate to a colorless end point.

To obtain the sulphur value of the standard potassium iodate run samples of known sulphur content. Multiply the ml thiosulphate by the potassium iodate factor and subtract from the ml iodate. Divide the per cent sulphur by the net potassium iodate and multiply by 100 to obtain the per cent sulphur represented by one ml of the standard potassium iodate. Since the solution is standardized by running through samples of the type to be analyzed, it is not necessary to subtract a blank. In any case a blank run on a sulphur-free material should not be more than 0.1 ml.

Discussion

In Table 1 are listed some results obtained by the foregoing method. The standard solutions used in titrating the samples had been freshly prepared from C. P. analyzed chemicals and the theoretical factor of the potassium iodate was used in calculating the results. The results were in excellent agreement with the amounts of sulphur present. Tests with a great many copper-base alloys have shown that the amounts of lead normally found in these alloys will not interfere by forming insoluble sulphates.

Any nitric acid or bromine left in the solution will vitiate the results. The sample is best fumed by heating over a burner while swirling the flask. Just before the last of the nitric is expelled the solution foams up. After that the heating is continued until no more perchloric fumes are visible inside the flask.

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Brass and Bronze Ingot Institute Starts Advertising Campaign

Changed to more clearly define the coverage and activity of the organization, the Non-Ferrous Ingot Metal Institute has been renamed the Brass and Bronze Ingot Institute. This was announced by Institute Secretary I. Glueck, following a meeting held in January at Miami Beach, Fla.

Leo Halpern, assistant to the president of Federated Metals Division, American Smelting & Refining Co., was elected president of the institute at the meeting. He succeeds Benjamin Harris, of Benjamin Harris & Co., Chicago, who was president of the organization for 20 years.

The Brass and Bronze Ingot Institute embarked on a magazine advertising program in January to promote the use of brass and bronze castings. Expected to be continued for several years, the program is directed at designing engineers and architects.

The two-page color advertisements are designed to point out and emphasize the advantages of cast brass and bronze, and to promote their greater use in many diversified fields.

A limited number of reprints of the advertisements is available. Requests should be sent directly to Brass and Bronze Ingot Institute, Room 1608, 308 West Washington St., Chicago 6, Ill.

Plan Non-Ferrous Cost Clinics

Non-ferrous foundries are operating at an average of 60 per cent capacity, according to a report made at the board of directors meeting of the Non-Ferrous Founders' Society February 8 and 9 in Cleveland. The society is planning to sponsor cost clinics about the country in an effort to help non-ferrous foundrymen solve problems arising from decreased production volume.

Another major topic of discussion at the meeting was the effect of the aid-to-Europe program on American non-ferrous foundries.

SMALL FOUNDRIES CAN ENGAGE IN RESEARCH AND DEVELOPMENT

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Emphasis placed on research throughout the war period has been expanded into the present. In the foundry, appeals for continued and additional research have been made by many—the industry's leaders,[1, 2] the association and trade journals, educators, and others. This enthusiastic promotion of research in the foundry has been shown by various articles portraying the activities of such research organizations as those of American Brake Shoe Co., International Nickel Co., Inc., U. S. Navy, U. S. Army, and others. However, as in many similar cases, the enthusiasm of the authors failed to be transferred to the average foundryman. In fact, exaltation of such exceptional investments for research has the adverse effect of widening the breach between consideration of and practice of research in the foundry.

The foundryman whose total capital investment may be but a fraction of the cost of one of these portrayed laboratories does not find an avenue of research for himself in reading of such giant enterprises. Naturally the foundryman may feel that with such magnitude of competition in the field of research his own opportunities would be but poor financial risks. He must have better assurance of personal success in research before he will consider entering such a program.

The object of this paper is to show that not only do some opportunities remain in the field of foundry research, but that these opportunities are especially tailored or restricted for the enterprising small foundry. To illustrate this point highlights are given of a typical study of current progress in the organization of research and in the foundry research achievements.

Research Opportunities

A study of the organization of research immediately justifies the belief that there must be considerable gaps in the field of foundry research as conducted by individual concerns. These gaps exist by deliberate restriction of the scope of operations of a research department by its management. This is a sound business practice, consistent with the conservative attitude of management of large concerns. This definition of scope (fencing off) of the research field is regarded as a main rule of organization of research, and is found without an exception known to the writer.[3, 4, 5] Published research activities, visits to the laboratories, discussions with pertinent personnel all verify this fact that management must keep its research within definite limits.

Since each concern establishes definite research limits for itself, an examination of the operations of all concerns is necessary as a whole to determine whether they have completely blanketed the field with or without overlapping. This examination must also show whether exposed (unblanketed) regions can be fruitful for the average foundryman. Such an examination results in a classification of activities under several headings:

A. Agencies which practice research are (1) individual firms, both large and small; (2) associations of producers banded together according to their specialty; (3) associations of users; (4) combinations of the users and producers in large and small groups, and (5) the overall metal industry associations.

B. These agencies follow certain principles to guide their research programs. For the majority of the projects the phrase "bigger (more), better, cheaper" serves adequately as the guiding principle. More specific guiding principles can be attributed to subdivisions of the agencies listed, and are given here together with examples of the results of such guided research.

A. Research and development conducted by individual concerns for themselves:

1. Foundry equipment manufacturing concerns: Research activities are devoted to (a) the production of more efficient equipment and (b) expanding uses of existing equipment, both concerned with salable major and minor items. Examples are improved and new melting equipment, sand handling systems, dielectric drying of cores, improved applications of indicating, controlling and recording accessories, and die casting machines.

2. Foundry metal producers, both large and small: These people are concerned with development (a) of higher production rates of higher quality metal, (b) the uses of these metals, (c) the development of sources of these metals, and (d) new alloys within the major category. Great attention is being given the study of high-temperature-resisting alloys and the development of continuous casting processes. Other examples are improvements in alloys of most common types.

3. Foundry materials producers: As in the case of the metal producers, the foundry material producers are concerned with development of (a) higher production rates, (b) uses of these materials, (c) sources of these materials, and (d) new subdivisions of these materials. Examples of such projects are sand, binder and coating developments, improved refractories and

methods of furnace lining. However, this field is very attractive to other material suppliers which seek more diversified markets, for example, graphite core developments, metal molds and cores, phenolic resins and refractory ceramics in core and molding materials, exothermic feeding materials (the last named is also an example of foundry process improvement).

4. Foundry test equipment manufacturers: Their research and development is along the lines of (a) manufacturing test equipment and (b) significance of tests in the foundry. Sand testing equipment development is certainly well publicized. Other developments are along such lines as rapid spectrographic analyses, electrolytic metallography work, crack and flaw detection by magnetic, supersonic, electric, and radiographic means, and physical property test equipment such as fatigue testing and high temperature strength testing.

5. Specialty parts foundries: Their research and development is directed toward foundry methods for improved quantity and quality (the "better and cheaper"). Examples of such developments are the precision or lost wax process casting methods, the permanent mold casting of cast iron, ladle inoculation practices, and pouring techniques studied by motion picture radiography.

Cooperative Research

6. The users of foundry products: Concerned with getting the most efficient product technically and economically. These usually enter a cooperative research arrangement by which the metallurgists of the user concerns set up requirements of foundry products which are presented to the providers of these products. Together they work out the details completely through service testing of products. The users of foundry products usually develop multi-metal combinations, composite fabrication practices, control practices, as well as continually pressing for better quality at lower costs from suppliers.

7. A miscellaneous group: For example, mathematicians who develop statistical and probability methods which are adapted to foundry practices; the air conditioning field which will permit development of alloys previously associated with noxious objectionable fumes. The latter would then pass into the category of foundry equipment producers.

B. Research and development by associations of producers. Although these present many phases of the foundry, they are not as common (nor as publicized) as in many competitive branches of industry. Examples of such producer associations are:

1. Gray Iron Research Institute, Inc., members have a common interest in improving (a) the metallurgical quality of their products and (b) operational efficiency. Their short-range goal is improvement in present types of cast iron, and the long-range projects are development of superior types of gray iron and methods of producing them uniformly and consistently.

2. The Association of Manufacturers of Chilled Car Wheels is a group engaged in improving the quality of the cast iron chilled car wheel and is concerned with metallurgy and with design, foundry procedures and methods, cupola control, chill control, and annealing procedures. The faith that this group shows in the sponsorship of research on a product with a 135-year manufacturing history is a strong argument for research.

3. The Alloy Casting Institute consists of steel foundries specializing in heat-resistant and corrosion-resistant castings. Their research is directed on such problems as selection of suitable compositions, effects of various alloying agents, and melting and pouring practices.

C. Research and development by the associations of users. The problems of this group are similar to those of individual users and their projects are guided by the same principles given in Group *A*, Section 6. This group is especially concerned in control practices and pressing for better quality at lower cost. Examples in this group are the Army and Navy and such associations as the Society of Automotive Engineers. To some extent the examples given are also producers.

D. Research and development by combinations of users and producers. The individual arrangement is most common and has been often sought, especially by the users.[6] The principles are similar to those already given in sections *A, B,* and *C*.

A.F.A. Sponsors Research Projects

E. Research and development by the industries overall associations. The American Foundrymen's Association has taken many measures to promote research in the foundry, especially through publication of articles of merit. However, in delineating sponsorship for projects the association has the difficult problem of selecting those which will benefit most if not all of the membership. The development of sand control methods (promoting Group *A*, Section 4) is unique, yet even this work misses some members for sand has more rivals as core and mold material now than previously. A suitable diversity of projects is one of the association's principal problems. A tabulation of active research projects under A.F.A. sponsorship will be found on this page.

The listing under groups is not intended to be complete. There have been many reviews of recent foundry developments presented in most metal industry periodicals. However, the brief listing is given for the purpose of demonstrating the classification of research which has proven useful for justification or rejection of various projects suitable to any type of organization. That

A.F.A. RESEARCH PROJECTS

Aluminum and Magnesium—Mechanics of molten metal flow in molds—Battelle Memorial Institute, Columbus, O.

Brass and Bronze—A study of the fracture test as an indication of the quality of tin bronzes—University of Michigan, Ann Arbor.

Centrifugal Casting—Centrifugal casting of light alloys—Canadian Bureau of Mines, Ottawa, Canada.

Cupola—Investigations of coke for cupola melting—Battelle Memorial Institute, Columbus, O., Canadian Bureau of Mines, Ottawa, Canada, and various plants.

Heat Transfer—Studies on thermal conductivity of sand and solidification of metals—Columbia University, New York, and Battelle Memorial Institute, Columbus, O., and various plants.

Malleable Iron—A study to establish the most suitable microstructure for pearlitic malleable iron for selective hardening—University of Michigan, Ann Arbor.

Steel—Influence of mold conditions on development of hot tears in steel castings—University of Kentucky, Lexington.

classification required by each concern can be prepared on the basis of the foregoing outline, containing only the data pertinent to the individual.

Obviously in such an analysis for an individual concern the work of the other individual concerns (Section *A*) requires most attention since these are the most flexible of the groups considered. Combinations of individual concerns, while benefiting the group as a whole, are more definitely restricted in scope than individuals. The Gray Iron Research Institute, for example, could not without change in corporation charter promote other than gray cast iron, whereas an individual foundry with an electric-arc furnace may change without serious inconvenience from low-alloy steel to gray cast iron, high-alloy steel, or other alloys. Also restrictions exist in that each individual in the Institute must get definite assistance; otherwise interest will be lost. Therefore, the leading individuals are restrained by the laggards. There is a definite and sound place for these associations in the research field; the point being stressed here is that individuals concerned with their private research program can more positively classify association work.

Gaps in Research Fields

A well-known incident will help to demonstrate that the individual and group research is so keyed to distinct fields that many fruitful gaps exist. The automotive industry is one of our national giants. It would be expected that production methods for engines would be a principal feature of their research work, and so it is. However, a radical but highly effective production method was developed by a smaller manufacturer outside of the large group. This method is the production of an engine block made entirely from stampings and simple shapes which are joined by brazing. Although a problem solved is always an easy one, there is not much reason to suspect that the large automotive groups could not have developed such a unit. The reason they did not is more that such a development was outside their scope of development work at present. The fact that large industries cannot foster such unique developments which outdate their present investment is of basic importance to the smaller enterprises.

The foregoing illustration has another point for the foundry industry, and that is that the development of a serious threat to some of its business (loss of block casting trade) does not need to come from large competitive industries. By analogy, the comparatively small foundry business should be able to attract business away from competitive fabrication industries.

The foundries have been insufficiently aggressive in seeking new business, usually competing with fellow foundrymen in other alloy fields. At the same time other competing fabricating methods have been reducing the available business. John Bolton [1] stated that one of the weakest links in the foundry structure at present is the work on applications and uses of foundry products. This weak link exists despite the efforts of the foundry metal producers (Section *A*, No. 2) and the associations of producers (Section *B*). The efforts of the former, however, are divided, since most of them also provide the metals used in competing fabrication processes.

The average foundryman does not have the variety of financial baskets in which to distribute his eggs that are available in large concerns. But this fact that more care will be taken promises correspondingly better results. It is of course granted that the novel idea is only one ingredient in a successful enterprise. The economics of pioneering developments is a separate study. However, any man who has taken his business through severe periods is alert to these requirements.

Methods of research conduct in contrast to selection of projects are beyond the scope of this paper. However, the attitude that a large, complete laboratory must be individually financed by each concern before research can be attempted is as great an error as the need for maintaining various legal counselors or a complete advertising firm. The average industrialist does not begrudge large industry its self-maintained advertising services, and he need not begrudge it the laboratories and technical specialists. Technical services are specifically important in the research work, and are available commercially as are advertising services when the latter are needed.

It is necessary for the foundry going into research not only to be acquainted with the work of their vendors and their representative associations but to use all the benefits of this research. All foundries are paying directly or indirectly for much research, and it is sound business to insist on getting the benefits.

Summary

The small foundry is being reduced to an unhealthy business state of casting standard alloys for a local region or for conventional requirements. Both of these sources of business are being reduced by competitive fabricating methods. Research has been proposed by many as the means by which the foundry industry can improve its business position. This paper has outlined a method of classification of the research activities in the foundry field for the purpose of locating the best avenues for the individual smaller foundry. The end result of a thorough classification by this method will have the benefits of a potential market analysis as made by economists. Certainly such classification should precede and complement market studies. The location of an "idea" for foundry research with respect to such a classification can be assured with the calculable probability of error of market analyses.

References

1. John W. Bolton, "Foundry Metallurgy in the Castings Industry," Transactions, American Foundrymen's Association, vol. 43, pp. 1–56 (1943).
2. H. F. Taylor, "Gray Iron Progress Through Research," *The Foundry*, vol. 74, no. 4, Apr. 1946, p. 106.
3. F. R. Bichowsky, *Industrial Research*, Chemical Publishing Co., Brooklyn, N.Y.
4. W. M. Pierce, *Metals Technology*, vol. 11, no. 3, T.P. 1726.
5. *Chemical & Engineering News*, Research Articles.
6. H. O. West, "What the Aircraft Industry Wants," Light Metals Conference, Seattle, Wash., 1945.

1947 Transactions Mailing Started

Mailing of the 1947 bound volume of Transactions of A.F.A., volume 55, started March 15. Sent in response to an order blank previously mailed, the paper covered volume comes to members at no cost.

Cloth bound volumes of Transactions for 1947 can be purchased by A.F.A. members for $2.00. The nonmember price is $15.00.

ENGINEER IN THE FOUNDRY

Marvin W. Williams
Foundry Manager
Hughes Tool Co.
Houston, Tex.

THE FOUNDRY INDUSTRY is among the largest in the United States and has many inducements to offer the engineer. There are many interesting and fascinating problems of metallurgical, electrical and mechanical engineering awaiting solution. The industry is acquainted with the dependency it must place upon the engineer. Far-sighted operators of foundry businesses are aware that this era is not necessarily one of reconversion from the effects of the recent war, but one of readjustment for the future. The foundryman is alert to change and new methods in his industry.

Ancient Art

Founding is one of the oldest known methods of producing metal parts, and dates back to Biblical times. The art of casting metal was first exercised in the making of ornamental objects, and the products of many of these early foundries are exhibited objects of permanent interest in museums.

Today every individual's life is affected by the castings produced by foundries across the nation. The technique of producing castings was practiced in Europe before the discovery of America. The casting of church bells developed into a large business in Europe, and some of the first foundries established in America manufactured bells. The industrial history of this country cannot omit the romance of the foundries which grew up with other factories to create an industrial nation.

The foundry industry of today is a basic industry. Each year foundries of this country produce millions of tons of castings in all sizes, shapes and types of metal. Physical properties of castings have increased with improved techniques of manufacture and treatment, and it is now recognized by designers that well-made castings have a wide field of application. Castings are universally used in transportation, communication, agriculture, manufacturing, construction and mining.

It is estimated that each modern home uses more than a ton of castings, and this figure is increasing daily with the installation of more mechanical and electrical appliances. The automobiles we drive include many castings such as cylinder blocks, cylinder heads, pistons, brake drums, piston rings, gear housings, crankshafts and camshafts. The trains on which we ride and transport our freight are constructed of many castings. Castings are an important aid in the production and transportation of water, oil, coal, gas and electric power.

Engineering Important

It is evident that the casting industry is fundamental to the development of our community and our industrial expansion. It is an industry in which the knowledge and ability of engineers are of utmost importance, and one in which the opportunities are many, because of the many interesting problems awaiting solution.

Reprinted from *Texas Professional Engineer*, Sept.-Oct., 1947.

How is engineering used in this basic industry? First, let us define the two: the engineer and the foundry. An engineer is a builder. He is one who uses his knowledge of the arts and sciences to convert the natural sources of power and the properties of matter into useful structures, machines and manufactured products. A foundry is an enterprise where metal is melted and poured into molds of predetermined shape and size. Then the foundry does apply the basic principles of engineering, because the melting of metals is a conversion of matter by applying heat, and the pouring into molds produces a metal part useful to man.

How does the engineer apply his knowledge of the arts and sciences in the foundry enterprise? Like other industries, the foundry is only the practical and useful application of the basic engineering sciences, physics, chemistry and mathematics. Specialized training would be of benefit to the newcomer in the foundry; however, with the knowledge of these basic sciences and their judicious application, one will quickly acquaint himself with conditions which are unique to the industry.

Covers Many Engineering Fields

An engineer can find many places in the foundry where his services are required, such as research, chemical and physical analysis, metallurgical, mechanical repairs to operating equipment and processing. Since foundry organizations may vary in size from those employing only a few people to those employing hundreds or thousands, the engineer may specialize in a particular phase of the enterprise or become a jack-of-all-trades and turn his abilities to channels remote from the usual fields of engineering.

Engineers in the foundry industry will find a diversity of metals to choose from, such as steel, gray iron, malleable iron, brass, aluminum and magnesium. To illustrate further the diversity of this industry, a review of the technical papers covering the foundry industry for the past year reveals a few along strictly metallurgical lines; whereas, many of the papers are devoted to processes, material handling, improving techniques, improving working conditions and the apparently quite extensive mechanization of plants.

Foundries are composed of five basic departments, namely: molding, core-making, melting, cleaning and management. The technical man finds intricate problems in each of these departments; however, before the foundry operations begin, the pattern must be made. The pattern is made from the design drawing provided,

and it is at this point that the foundryman must plan the procedure to be used in processing the casting through the five foundry departments.

The molding department makes the sand molds into which the molten metal is poured. Sand cores for the inside surfaces of the castings are produced in the core making department. The sand cores are baked to the proper hardness under the same care that a baker might use in baking bread.

The melting department furnishes the molten metal for the molds. The melting of metal is a chemical reaction which takes place at high temperature, and the control of this chemical reaction is vital to the final product. The chemical content of the raw products which go into the melting furnace and the chemical reactions which occur in the furnace must be regulated to produce a metal of the desired chemistry.

After the molds are poured they are broken open and the metal castings are removed from the sand. The cleaning operations then start by removal of the feed gates and risers. The casting is then ground and chipped smooth and may be tumbled or blasted to remove adhering sand and scale. The castings are then heat-treated to bring forward the desired physical properties of the metal.

Management is the control department. It furnishes the machines, material and men, and maintains control over the operations. It is the control department which may design, install and maintain equipment for processing of the materials. It is in this department that the engineer may see his ideas grow from a blueprint on the drafting board to an actuality in the plant.

Controlling Processes

Engineering service is required in the control department, because foundrymen recognize the need for testing raw materials and for checking at various stages in the manufacturing process. The industry is familiar with the value of engineering in layout, laboratory practice, melting practice, production control, material handling, pattern and molding equipment, and in other fields of activity such as purchasing and selling.

An engineer must acquaint himself with the rules of fire prevention, safety and industrial health; for in the foundry he must appreciate the personal dangers involved in all of the processes, and aid in eliminating unsafe practices and conditions.

The engineer in the foundry must learn to talk, to translate his scientific ideas into language understandable to the layman, and likewise to interpolate the art of the industry into scientific facts. It is those occurrences in the founding process that we know to be correct by "trial and error" which must be converted into scientific facts, thereby eliminating guess work. Foundrymen have said that certain processes were not possible, yet someone who did not know they were impossible has adapted the process by applying concrete principles and scientific practices.

The recent war has focused the industry's attention on science and engineering more than ever before. It has increased the engineers' professional obligations, because they must be more alert businessmen, must know the newest and best methods and must interpret these new and better methods into realities. The engineer must concern himself with the building of an enterprise with a capable organization.

Chicago Chapter Lecture Course Covers Scrap Cause and Prevention

The 1948 Lecture Course of the Chicago Chapter opened February 27 at the People's Gas Building Auditorium. Robert P. Schauss, foundry superintendent, National Malleable & Steel Castings Co., Cicero, Ill., spoke on "Present Day Melting Problems." Chairman of the meeting was A. W. Gregg, executive engineer, Whiting Corp., Harvey, Ill.

Consisting of four lectures, the general theme of the course is "Scrap—Its Causes and Prevention." Registration already totals 485 according to Lecture Course Chairman Oscar R. Blohm, Triangle Foundry Co., Chicago. A $1.00 fee is charged for the course and a certificate is awarded to all who attend at least three of the four lectures.

The second lecture, on sand, will be March 17. Gating and risering will be discussed at the third lecture; scheduling difficulties have prevented setting a definite date. The fourth lecture, set for April 23, will deal with casting defects as covered in the new A.F.A. publication, ANALYSIS OF CASTING DEFECTS.

Pattern Committee Outlines Book

The Pattern Manual Committee of the Pattern Division met February 23 at A.F.A. Headquarters, Chicago, to formulate an outline for the proposed PATTERNMAKING MANUAL. The content of the proposed text was thoroughly discussed. The committee also contemplates writing a manual specifically for purchasers of foundry patterns and pattern equipment.

Those present at the meeting were: H. K. Swanson, Swanson Pattern & Model Works, East Chicago, Ind., *Chairman,* G. W. Schuller, Caterpillar Tractor Co., Peoria, Ill., W. A. Bolton, Link Belt Co., Chicago, Al Huebner, Allis Chalmers Co., Milwaukee, Len Gratz, G. & O. Pattern Works, Milwaukee.

FUTURE CONVENTIONS AND EXHIBITS

American Society of Tool Engineers, 16th Annual Meeting and Tool Exposition, Cleveland—March 15-19.

Magnesium Association, 4th Annual Meeting, Pennsylvania Hotel, New York City—March 18-19.

Chicago Technical Societies Council, Chicago Production Show, Stevens Hotel, Chicago—March 22-24.

National Association of Corrosion Engineers, Jefferson Hotel, St. Louis, Mo.—April 5-8.

Southern Machinery and Metals Exposition, Atlanta, Ga.—April 5-8.

Openhearth Steel Committee and Coke Oven, Blast Furnace, and Raw Materials Committee, AIME, Annual Conference, Pittsburgh—April 12-14.

American Chemical Society, National Meeting, Chicago—April 19-23.

American Ceramic Society, 50th Annual Meeting, Chicago—April 24-30.

American Foundrymen's Association—52nd Annual Convention and Exhibit, Philadelphia—May 3-7.

Society for Experimental Stress Analysis, Annual Meeting, Roosevelt Hotel, Pittsburgh—May 27-29.

American Society of Mechanical Engineers, Semi-Annual Meeting, Milwaukee—May 30-June 4.

American Society for Testing Materials, 51st Annual Meeting, Detroit—June 21-25.

Czechoslovakian Foundrymen Plan International Foundry Congress

BULLETIN—*Effect of recent political disturbances in Czechoslovakia on the International Foundry Congress has not been reported as* AMERICAN FOUNDRYMAN *goes to press. News related to the Congress will appear in future issues.*

The first post-war International Foundry Congress and Exhibition will be held in Prague, Czechoslovakia, September 15-19. A week-long series of visits to Czechoslovakian foundries and metallurgical works has been arranged for September 20-26.

Lester B. Knight of Lester B. Knight & Associates, Chicago, has been invited by the A.F.A. Board of Directors to be the official Association representative at the international meeting.

Last held in London in 1939, the International Foundry Congress has not been in America since the A.F.A. Convention in Philadelphia, October 22-26, 1934. The 1942 Congress was cancelled.

The Congress is being organized by a committee of Czechoslovak Foundry Technical Association members under the chairmanship of F. Pisek, professor of foundry engineering, Institute of Technology, Brno. Honorary secretary of this committee is L. K. Jenicek, of the Mining and Metallurgical Institute.

Congress papers, which will cover a wide range of foundry topics, will be published as preprints and also in bound form. Papers will cover especially such topics as foundry layout and mechanization, precision and centrifugal casting, casting cleaning and finishing, casting design from the founder's viewpoint, foundry metallurgical processes, and testing of metals and castings. Papers on these subjects and all other foundry subjects will be welcome and are solicited.

The Foundry Exhibition will be held in conjunction with the Prague Autumn Fair, September 12-19. During this period visitations will be arranged to important foundries in and around Prague. Following the Congress, visitors will be able to visit the most important industrial centers of Czechoslovakia.

For the convenience of accompanying family members, a special entertainment program is being arranged. This will include visits to historical parts of Prague and Czechoslovakia, and also the food, shoe, and glass industries.

Prospective authors, exhibitors, and Congress visitors can get full information from L. K. Jenicek, Prague 11, Trida Jana Opletala 55, Czechoslovakia.

Technical Conference Talks Theme "What Metals for Your Castings"

Theme of the Chicago Chapter-sponsored sessions at the Chicago Technical Conference and Production Show at the Stevens Hotel, March 22-24, is "What Metals for Your Castings" according to Chapter President Fred B. Skeates, foundry superintendent, Link-Belt Co., Chicago.

Proper uses and advantages of the major classes of alloys will be covered in two two-hour meetings March 24. Robert D. Phelps, secretary, Francis & Nygren Foundry Co., Chicago, is the gray iron speaker. John A. Rassenfoss, research metallurgist, American Steel Foundries, East Chicago, Ind., will talk on steel.

When to use non-ferrous castings will be explained by Herman L. Smith, chief metallurgist, Federated Metals Division of American Smelting & Refining Co., Pittsburgh. The speaker on malleable iron will be James H. Lansing, consulting engineer, Malleable Founders' Society, Cleveland.

Chairman for the steel and malleable meetings is C. V. Nass, vice-president and general manager, foundry division, Pettibone-Mulliken Corp., Chicago. A. W. Gregg, executive engineer, Whiting Corp., Harvey, Ill., is chairman of the sessions on gray iron and non-ferrous casting alloys. Carl F. Lauenstein, chief metallurgist, Link-Belt Co., Indianapolis, Ind., is co-chairman of the malleable meeting.

Oregon State College Students Plan First West Coast Student Chapter

Thirty Oregon State College students have petitioned to form the fifth student chapter of the American Foundrymen's Association. Student officers will be elected soon, according to John P. Meece, acting secretary for the group at Corvallis.

Faculty adviser is Professor Harry R. Dahlberg, of the industrial arts department. W. B. Kirby, engineer, Electric Steel Foundry Co., Portland, will provide contact between industry and the Oregon Chapter of A.F.A. as industrial adviser to the OSC student group.

Experienced in student chapter work, Professor Dahlberg was chairman of the University of Minnesota Student Chapter during the school year 1942-43. He won the 1943 A.F.A. Student Essay Contest with a paper entitled "The Effect of Graphite Particle Size in the Inoculation of Gray Cast Iron." Joining the OSC faculty after serving in the navy, he has stimulated interests in foundry careers among his engineering students and has placed many of them in summer jobs where they can gain industrial experience.

Enroll Over 125 in Chapter Course For Detroit High School Students

The second phase in the Detroit Chapter educational program got under way when the first of a series of four two-hour lectures was given March 10. Enrollment in the lecture course, which is directed at high school students, is over 125. The remaining lectures will be on March 17, 24, and 31.

Taught in the University of Detroit physics lecture room, the course speakers and subjects are: R. J. Ruff, sales manager, Young Brothers Co., "Selling Foundry Products"; G. Vennerholm, metallurgist, Ford Motor Co., metallurgical subjects; Vaughan C. Reid, vice-president, City Pattern Foundry & Machine Co., "Foundry Management"; Harold Schroeder, works manager, Michigan Steel Castings Co., plant operations. Assisting Mr. Schroeder will be R. J. Wilcox, technical director, and J. J. Kelly both of Michigan Steel Castings Co.

The second phase in the Detroit Chapter educational program, the lecture course follows a highly successful public speaking course just completed.

WHO'S WHO

M. W. Williams

A native Texan, Marvin W. Williams obtained his mechanical engineering degree from the University of Texas, Austin . . . Following graduation from college, in 1935, he became associated with the Hughes Tool Co., Houston, as a member of the sales department . . . In 1945 he assumed the position of foundry manager, Hughes Tool Co. . . . An A.F.A. member he is Chapter Chairman of the Texas group . . . He is a Texas-registered engineer and a member of the Steel Founders Society and ASM . . . See page 57 for his paper the *Engineer in the Foundry.*

Everett Laitala

From the far northern mining sector of Minnesota comes author Everett Laitala . . . Birthplace: Ely . . . Worked as a miner for two years before attending college . . . Was associated with Oliver Iron Mining Co. . . . Graduated from the University of Minnesota, Minneapolis, in 1934, receiving a Bachelor of Science degree with distinction in mechanical engineering . . . Became affiliated with Prest-O-Lite Co., Inc., Indianapolis (1936) and held a number of positions with that firm . . . Began as assistant shop foreman and was advanced to head, manufacturing research; chairman, cost reduction committee; and head, methods, standards and estimating department . . . Returned to University of Minnesota in 1937 and obtained his Master of Science degree . . . From 1940-47 he held the position of assistant professor of mechanical engineering, University of Minnesota . . . Last year went to the University of Illinois, Urbana, as associate professor . . . In 1945, Mr. Laitala was given his professional mechanical engineering degree from Minnesota. Acted as a consultant to a number of Minnesota industrial plants, and was management consultant to the WPB, Region XII, Minneapolis . . . Taught many special classes in industrial plants in the field of industrial engineering . . . Has talked before a number of technical societies relative to industrial engineering principles . . . Organizations in which he holds memberships are: Society for Advancement of Management and American Society for Engineering Education . . . *Economics of Castings Use,* pages 48-51, is the title of Mr. Laitala's article in this issue of AMERICAN FOUNDRYMAN.

Harry Czyzewski

A metallurgical engineering graduate from the University of Illinois, Urbana, Harry Czyzewski is assistant professor in the metallurgical engineering department at Illinois . . . He is preparing a series of problems on experimental and research foundry plans in conjunction with securing the degree of professional engineer . . . He also is working toward a doctorate degree . . . He was formerly connected with the research department, Caterpillar Tractor Co., Peoria, as staff metallurgist and also taught metallurgy at Bradley Polytechnic Institute, Peoria . . . Is head, Metallurgical Engineers, Inc., Portland, Oregon . . . Has written previously for the American Foundrymen's Association . . . See: *Small Foundries Can Engage in Research and Development,* page 54 of this issue for his latest paper. Mr. Czyzewski is a member of A.F.A. and the Oregon chapter.

1947 INDEX

Index to volumes 11 and 12 of AMERICAN FOUNDRYMAN, cataloging material published in 1947, is enclosed with this issue of the magazine.

A limited number of extra indexes for 1947, for 1946, and for 1945, is available at no cost to A.F.A. members and subscribers who need additional copies.

H. J. Nichols

Thirty-five year old H. J. Nichols was born in London, England . . . Higher education was obtained from McMaster University, Hamilton, Ont., Canada, where Bachelor and Master of Science degrees were awarded him in 1941 and 1942, respectively . . . Was associated with Steel Co. of Canada, Hamilton from 1935-41 as metallurgist . . . During 1942-43 was welding metallurgist, General Motors, Oshawa, Ont., Canada . . . Joined the mineral dressing and metallurgical division, Canadian Bureau of Mines (1943) and was appointed welding engineer . . . His findings have been published by various welding journals in Canada and the United States . . . Has written for AWS on welding metallurgy . . . Membership maintained in ASM, AWS and Canadian Welding Society . . . H. J. Nichol's paper *High Hardenability Steels Salvaged by Welding* appears on pages 46-47 in this issue.

R. J. Wolf

A member of the American Foundrymen's Association and a frequent contributor to the trade press, Richard J. Wolf was born in Cedar Rapids, Iowa . . . He obtained a Bachelor of Science degree in mechanical engineering from Iowa State College, Ames, in 1922 and five years later was awarded his professional degree of mechanical engineering from the same college . . . Took graduate work at Chicago University, Chicago (1933) . . . Began his industrial career in Buffalo, N.Y., as a development engineer, with Hayes Process Co. and Industrial Furnace Corp. . . . From 1937-41 was foundry engineer, Carnegie-Illinois Steel Corp., Gary, Ind. . . . Held the same position with Sears-Roebuck & Co., Chicago, in 1941 . . . As a member of the armed forces, he served as a lieutenant commander, U.S.N.R., and was stationed at the U. S. Naval Gun Factory, Washington, D.C., as assistant production

officer . . . Joined Stone & Webster Engineering Corp., Boston, in 1946, as engineer, industrial division . . . Pages 25-33 contain Mr. Wolf's paper, *Foundry Safety and Hygiene.*


S. W. Healy

Cupola Operation with Heated Blast is the paper prepared for this issue by Sam W. Healy; it starts on page 44 . . . The author is assistant general manager, Central Foundry Division, General Motors Corporation, Saginaw, Mich . . . He has been a member of this organization since 1926 . . . Place of birth: Saginaw, Mich. . . Sponsored by the Cupola Research Committee, American Foundrymen's Association, Mr. Healy's paper is the first in a series of papers on modern cupola operation planned by the committee.


Milton Sherman

Illinois Institute of Technology is the alma mater of Milton Sherman . . . The Chicago institution conferred a Bachelor of Science degree in chemical engineering upon him in 1942 . . . Following graduation he became associated with the Pittsburgh Testing Laboratory, Chicago, as chemist . . . From 1944-45 he was chief chemist . . . In 1946 he was appointed chief chemist, Silverstein & Pinsof, Inc., Chicago . . . Has written papers for the American Association for the Advancement of Science concerning the methods of analysis of non-ferrous alloys . . . He also holds membership in American Chemical Society and ASTM . . . His paper, *Sulphur Determination* appears on pages 52-53.


R. P. Schauss

R. P. Schauss was graduated from Case Institute of Technology, Cleveland, 1938 with a Bachelor of Science degree in metallurgical engineering . . . His senior year he was awarded the Ferro Enamel Corporation Fellowship for the purpose of investigating the enameling characteristics of gray cast iron . . . After graduation he accepted a position as research metallurgist, Ferro Enamel Corp., Cleveland . . . Since 1939, Mr. Schauss has been affiliated with the Cicero plant, National Malleable & Steel Castings Co. . . . Starting as chief metallurgist he is now superintendent, malleable foundry . . . In this issue: *Modern Annealing Methods,* pages 34-38.

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Secretary-Treasurer, R. H. Van Hellen, Unitcast Corp.

TRI-STATE CHAPTER
Secretary, C. B. Fisher, Enardo Foundry & Mfg. Co.

TWIN CITY CHAPTER
Secretary-Treasurer, L. K. Polzin, Minneapolis Chamber of Commerce.

WASHINGTON CHAPTER
Secretary-Treasurer, A. D. Cummings, Western Foundry Sand Co.

WESTERN MICHIGAN CHAPTER
Secretary, D. A. Paull, Sealed Power Corp.

WESTERN NEW YORK CHAPTER
Secretary, F. L. Weaver, Weaver Materiel Service.

WISCONSIN CHAPTER
Secretary, A. C. Haack, Wisconsin Grey Iron Foundry Co.

STUDENT CHAPTERS

UNIVERSITY OF MINNESOTA *Secretary,* Harvey Saubey

MISSOURI SCHOOL OF MINES *Secretary,* Stanley Zirinsky

OHIO STATE UNIVERSITY *Secretary-Treasurer,* Eldon Boner

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Secretary-Treasurer, Martin J. O'Brien

◀ 4

New AFA MEMBERS

Period January 15 - February 15: New members total 151. Leading chapters of 36 reporting growth this period: Wisconsin, 23; Ohio State University, 21; Missouri Mines, 20; Massachusetts Institute of Technology, 16; Saginaw Valley, 13.

NEW SUSTAINING MEMBERS

Marathon Foundry & Machine Co., Wausau, Wis.—Arthur E. A. Mueller, Pres. (Wisconsin Chapter).

NEW COMPANY MEMBERS

Columbia Malleable Castings Corp., Columbia, Pa.,—H. Nelson Albright, Mgr. (Philadelphia Chapter).
LaSalle Builders Supply Ltd., Montreal, Que.—Colin B. Sewell, Sales Mgr. (Eastern Canada & Newfoundland Chapter).
Northwestern Marble Corp., Minneapolis, Minn.—David C. Gramling, Vice-Pres. (Twin City Chapter).
Precision Parts Corp., Nashville, Tenn.—George H. Harmon, Prod. Mgr. (Birmingham District Chapter).
Rife-Loth Corp., Waynesboro, Va.—R. H. Clemmer, Pres. (Chesapeake Chapter).
The Klotz Machine Co., Sandusky, Ohio—Vincent C. Lorenzen, Asst. Sec. (Northeastern Ohio Chapter).

MEMBERSHIP CONVERSIONS
From Personal To Company Membership

Harrison-Corry Co., Knoxville, Tenn.—Ormond C. Corry, Vice-Pres. (Birmingham Chapter).
Koppers Co., Inc., St. Paul, Minn.—R. A. Coolidge, Fdry. Slsmn. (Twin City Chapter).

BIRMINGHAM DISTRICT CHAPTER

***Precision Parts Corp., Nashville, Tenn. (George H. Harmon, Prod. Mgr.).**
L. L. Stone, Frm., Stockham Pipe Fittings Co., Birmingham, Ala.

BRITISH COLUMBIA CHAPTER

W. Eluck, Fdry. Frm., Mainland Foundry, Vancouver, B.C.
James Haydock, Pttrnmkr. Appr., Vivian Diesels & Munitions Ltd., Vancouver, B.C.

CANTON DISTRICT CHAPTER

Frank Martin, Cleaning Room Frm., The Ohio Injector Co., Wadsworth, Ohio.

CENTRAL ILLINOIS CHAPTER

David E. Locke, Sales, American Smelting & Refining Co., Whiting, Ind.

CENTRAL INDIANA CHAPTER

Robert E. Armstrong, Dist. Sales Mgr., Harbison-Walker Refractories Co., Pittsburgh.
Russell M. Bandy, Time Study Engr., International Harvester Co., Indianapolis.
Edward P. Cooke, Group Leader, International Harvester Co., Indianapolis.
William B. Huelsen, Prog. Stud., International Harvester Co., Indianapolis.
William Keegan, Fdry. Stud., International Harvester Co., Indianapolis.

CENTRAL NEW YORK CHAPTER

Robert Cushman, Abr. Engr., Norton Co., Worcester, Mass.
Norman E. Welch, Fdry. Frm., Sweets Foundry, Inc., Johnson City, N.Y.

CENTRAL OHIO CHAPTER

John S. Kohler, Prod. Mgr., Alten's Foundry & Machine Works, Lancaster, Ohio.

CHESAPEAKE CHAPTER

***Rife-Loth Corp., Waynesboro, Va. (R. H. Clemmer, Pres.).**
L. P. Dillon, Jr., Supt., Rife-Loth Corp., Waynesboro, Va.
A. A. Dobbs, Rife-Loth Corp., Waynesboro, Va.
Clarence L. Haldeman, Molder, Chambersburg Engineering Co., Chambersburg, Pa.
E. E. Shewbridge, Frm., The Maryland Car Wheel Co., Baltimore, Md.

CHICAGO CHAPTER

David W. Black, Owner, David W. Black, Chicago.
Richard G. Gieselman, Stud., Illinois Institute of Technology, Chicago.
John W. Greenstreet, Sales Repr., The Maryland Car Wheel Co., Baltimore, Md.
John C. Kinross, Sales, Carver Pump Co., Chicago.
Robert J. Schmidt, Asst. Met., Association of Mfrs. of Chilled Car Wheels, Chicago.
H. C. Shih, Trainee, Western Foundry Co., Chicago.
M. G. Slaney, Jr., Sec.-Treas., Riverside Iron Works, Chicago.
William H. Walter, Insp., Advance Aluminum Castings Co., Chicago.

CINCINNATI DISTRICT CHAPTER

Walter Clericus, Supv., Ohio Precision Castings, Inc., Dayton, Ohio.
Frank Maidhof, Frm., Sawbrook Steel Castings Co., Cincinnati.
Robert W. Schumann, Iron Fdry. Group Leader, The Lunkenheimer Co., Cincinnati.
Gordon F. Smith, Treas., The Martin Foundry Co. Inc., Covington, Ky.

DETROIT CHAPTER

Joseph M. Franz, Sales Engr., Harbison-Walker Refractories Co., Detroit.
Harry G. McCallum, Student, Pontiac Motor Co., Pontiac, Mich.
Willard C. Smith, Asst. Supt., Northville Foundry & Mfg. Co., Northville, Mich.
C. J. Snyder, Staff Master Mech., Chrysler Corp., Detroit.
Frank W. Sowa, Instr., University of Michigan, Ann Arbor, Mich.

E. CANADA & NEWFOUNDLAND CHAPTER

***LaSalle Builders Supply Ltd., Montreal, Que. (Colin B. Sewell, Sales Mgr.).**
J. W. Eller, Cons. Chemist, Milton Hersey Co. Ltd., Montreal, Que.
G. Letendre, Dir. Dept. of Mining & Met., Laval University, Que.

EASTERN NEW YORK CHAPTER

Charles F. Fuller, Insp., General Electric Co., Schenectady, N.Y.
John E. Kammerer, Core Room Frm., Albany Casting Co., Voorheesville, N.Y.
Edwin S. Lawrence, Fdry. Engr., General Electric Co., Schenectady, N.Y.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY STUDENT CHAPTER

Clyde M. Adams, Jr.
Lloyd R. Allen
Norman S. Andrews
Frederick Isaac Brown, Jr.
Diderick Cappelen
Randall K. Cleworth
Eustace Wm. Cummings
Loris M. Diran
John E. Fries, Jr.
Manvel B. Gassman
Gerald J. Grott
William Halbleib
Jan. M. Hoegfeldt
Leonard N. McKibben
Martin J. O'Brien III
Thomas George Zsembik

METROPOLITAN CHAPTER

Robert E. Christian, Asst. Met., American Brake Shoe Co., Mahwah, N.J.
Daniel C. Poor, Appr., American Brake Shoe Co., New York.

MEXICO CITY CHAPTER

Luis Cuesta, Engr., Fundiciones de Hierro Y Acero, S.A.
Luis del Moral Flores, Pttnmkr., Tezuiltan Copper Co., Pueblo.

MISSOURI SCHOOL OF MINES AND METALLURGY STUDENT CHAPTER

Darwin H. Bingham, Jr.
Edward L. Brundige
Edwin E. Cornelius
John H. Cox
W. M. Harris
Clarence A. Isbell, Jr.
Elias L. Kapernaros
Carl Walter Knoebel
Edward G. Littell
James Leslie Miller
John William Mitchell
Gordon H. Moline
Robert J. Niewoehner
William M. Parkinson
John Gay Reilly Jr.
James E. Reynolds, Jr.
Martin Leo Slawsky
Wilbern L. Weddle
Robert L. Williamson
Stanley Zirinsky

NORTHEASTERN OHIO CHAPTER

***The Klotz Machine Co., Sandusky, Ohio. (Vincent C. Lorenzen, Asst. Sec.).**
Victor B. Bidenharn, Sec.-Treas., M.B.M. Foundry, Inc., Garfield Heights, Ohio.
James Crane, Jr., Fdry. Engr., The Klotz Machine Co., Sandusky, Ohio.
A. J. Mackan, Sales, American Smelting & Refining Co., Cleveland.
Joseph P. Manwell, Vice-Pres., M.B.M. Foundry, Inc., Garfield Heights, Ohio.

* Company Members.

James Peters, Asst. Supt., Sterling Brass Co., Cleveland.
Charles Schneider, Frm., National Malleable & Steel Castings Co., Cleveland.
James T. Smith, Sales Engr., McBeth Machinery Co., Cleveland.
Lon Ulsenheimer, Frm., National Malleable & Steel Castings Co., Cleveland.

NORTHERN CALIFORNIA CHAPTER

Alfred C. Mayerle, Partner, Mayerle & Son, Oakland, Calif.
Paul Mayerle, Partner, Mayerle & Son, Oakland, Calif.

NO. ILLINOIS & SO. WISCONSIN CHAPTER

Gerald Doherty, Asst. Plant Engr., Gunite Foundries Corp., Rockford, Ill.

NORTHWESTERN PENNSYLVANIA CHAPTER

Francis M. McCracken, Fdry. Frm., Bucyrus Erie Co., Erie, Pa.
Paul N. Muscarella, Drafting Trainee, General Electric Co., Erie, Pa.

OHIO STATE UNIVERSITY STUDENT CHAPTER

Eldon Boner
Robert Bragg
Wilford P. Crise
Thomas S. Doyle
William E. Dundon
William H. Griffith, Jr.
James Hudgins
Joseph Leaverton
J. F. McKeard
Calvin E. Mettee
Karl Moltrech
William J. Mooney
Richard Morton
John W. Onibal
John H. Parks
T. S. Pendergast
Clifford Schutte
John L. Shinn
Kenneth Smith
Herald E. Starkey
George C. Williams, Jr.

ONTARIO CHAPTER

R. Frazer, Student, Canadian Hanson & Van Winkle Co. Ltd., Toronto, Ont.

PHILADELPHIA CHAPTER

*Columbia Malleable Castings Co., Columbia, Pa. (H. Nelson Albright, Mgr.).
William F. Beatty, Sales, Chicago Pneumatic Tool Co., Philadelphia.
M. J. Calciano, V.P., Charles Moosley's Sons, Inc., Philadelphia.
George E. Hunter, Maint. Engr., H. G. Enderlein Foundry Co., Philadelphia.
Edward Lincoln Hurst, Dist. Field Engr., Norton Co., Worcester, Mass.
William T. Tredennick, Gen. Mgr., Refractory Specialties Co., Philadelphia.

ROCHESTER CHAPTER

A. Renard Brown, Frm., The Anstice Co., Inc., Rochester, N.Y.
Ralph G. Hoppe, Pttnmkr., Eastman Kodak Co., Rochester, N.Y.

SAGINAW VALLEY CHAPTER

Walter I. Brisbois, Ind. Engr., Central Foundry Div., General Motors Corp., Saginaw, Mich.
Ralph Eggleston, Sales Engr., Precision Grinding Wheel Co., Inc., Detroit.
Matt L. Heppler, Student, General Motors Institute, Saginaw Malleable Plant, Saginaw, Mich.
Gerald E. Hynan, Proc. Engr., General Motors Corp., Central Foundry Div., Saginaw, Mich.
Carroll M. Jaquette, Teacher, Flint Technical High School, Flint, Mich.
Edward T. Kubilins, Jr., Met., Saginaw Malleable Iron Co., Saginaw, Mich.
James H. Langford, Jr., Student, General Motors Institute, Buick Div., Flint, Mich.
Archie McKay, Fdry. Frm., Saginaw Foundries Co., Saginaw, Mich.
James Sampson, Frm., Buick Motor Car Co., Flint, Mich.
Normal Schell, Mold. Frm., General Foundry & Mfg. Co., Flint, Mich.
Arthur P. Siewert, Met., General Motors Corp., Central Foundry Div., Saginaw, Mich.
T. S. Srinivasan, Student, General Motors Institute, Flint, Mich.
Harold F. York, Proc. Engr., General Motors Corp., Central Foundry Div., Saginaw, Mich.

ST. LOUIS DISTRICT CHAPTER

W. O. Gaumer, Asst. Chief Chemist, Koppers Co. Inc., Granite City, Ill.
H. Hirsch, Appr., American Brake Shoe Co., American Manganese Steel Div., St. Louis, Mo.
F. E. Miller, Jr., Supt., American Brake Shoe & Cstgs Div., No. Kansas City, Mo.

SOUTHERN CALIFORNIA CHAPTER

Louis J. Delaney, Sales Engr., Reliance Regulator Corp., Alhambra, Calif.
E. S. Todd, Chief Met., Lincoln Foundry Corp., Los Angeles.

TEXAS CHAPTER

H. E. Bland, Met., J. B. Beaird Co., Inc., Shreveport, La.
Ray P. Ogelthorpe, Fdry. Supt., Cunningham Machinery Corp., Shreveport, La.
C. Oscar Petterson, Tips Engine Works, Austin, Texas.
George Woodall, Hard Iron, Annealing & Finishing Supt., Texas Foundries, Inc., Lufkin, Texas.

TOLEDO CHAPTER

Warren E. Brace, Wood Pttnmkr. Appr., Mayer Pattern Works, Bryan, Ohio.
John E. Reed, Met., Spicer Mfg. Div., Dana Corp., Toledo, Ohio.
Richard L. Westerman, Metal Pttnmkr. Appr., Mayer Pattern Works, Bryan, Ohio.

TRI-STATE CHAPTER

William Deutch, Acme Steel & Metal Co., Tulsa, Okla.

TWIN-CITY CHAPTER

*Northwestern Marble Corp., Minneapolis, Minn. (David C. Gramling, V.P.).
Carl W. Carlson, Spec. Asst. to Fdry. Supt., Minneapolis-Moline Power Implement Co., Minneapolis, Minn.
Thomas D. Hicks, Mgr. Fdry. Supply Dept., Fire Brick Supply Co., Minneapolis, Minn.
Elroy E. Kusske, Asst. Frm., Molding, Minneapolis-Moline Power Implement Co., Minneapolis, Minn.
Herman L. Runsberg, Asst. Frm., Pttn. Dept., Minneapolis-Moline Power Implement Co., Minneapolis, Minn.
Eugene Richard Shelley, Sand Frm., Minneapolis-Moline Power Implement Co., Minneapolis, Minn.

UNIVERSITY OF MINNESOTA STUDENT CHAPTER

Vernon W. Grant
Bill Koppi

WASHINGTON CHAPTER

Charles E. Groce, Sales, R. Hoe & Co., Inc., Seattle, Wash.
Andrew F. Shearer, Owner, Shearer Foundry, Seattle, Wash.

WESTERN NEW YORK CHAPTER

Frederick C. Few, Jr., Frm., Patt. & Carpenter Shop., Dobbie Foundry & Machine Co., Niagara Falls, N.Y.

WISCONSIN CHAPTER

**Marathon Foundry & Machine Co., Wausau, Wis. (Arthur E. A. Mueller, Pres.).
Elmer H. Biersack, Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Charles H. Carpenter, Gen. Frm., Precision Cstg. Dept., Allis-Chalmers Mfg. Co., West Allis, Wis.
Frank Cooper, Core Frm., General Foundries Co., Milwaukee, Wis.
M. F. Cunningham, Gen. Frm., Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Frank Draheim, Fdry. Mgr., Marathon Foundry & Machine Co., Wausau, Wis.
Harold A. Einsiedel, Prod. Engr., General Foundries Co., Milwaukee, Wis.
J. M. Fordney, Chief Met., Marathon Foundry & Machine Co., Wausau, Wis.
Carl P. Gergen, Frm., Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Edward C. Gutkowski, Clean. Room Frm. & Chief Insp., General Foundries Co., Milwaukee, Wis.
A. Hackl, Frm., Allis-Chalmers Mfg. Co., Milwaukee, Wis.
E. Jaers, Frm., Allis-Chalmers Mfg. Co., Milwaukee, Wis.
J. Thomas Kelly, Jr., Office Mgr., General Foundries Co., Milwaukee, Wis.
Marvin A. Knoller, Sales Engr., Electro Refractories & Alloy Corp., Buffalo, N.Y.
Melville Lowe, Met., General Foundries Co., Milwaukee, Wis.
R. A. Mollica, Frm., General Foundries Co., Milwaukee, Wis.
Richard C. Mueller, Met. Engr., Universal Foundry Co., Oshkosh, Wis.
Edson J. Palmer, Asst. Fore., Allis-Chalmers Mfg. Co., West Allis, Wis.
Frank G. Schneider, Supt., General Foundries Co., Milwaukee, Wis.
Theodore Spella, Frm., Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Leslie E. Van Laanen, Core Room Supt., Marathon Foundry & Machine Co., Wausau, Wis.
Henry Wanserski, Fdry. Supt., Marathon Foundry & Machine Co., Wausau, Wis.
Jack G. Wollenburg, Asst. Fdry. Mgr., Marathon Foundry & Machine Co., Wausau, Wis.

OUTSIDE OF CHAPTER

George Lutoslawski, Tech. Adv., Embassy of Poland, Washington, D.C.
Howard D. McVicker, Res. Engr., Vulcan Mold & Iron Co., Latrobe, Pa.

Italy

Enzo Pradelli, Ing., Fonderia Soc. Acc. Corni & Co., Via Canaletto, Modena.

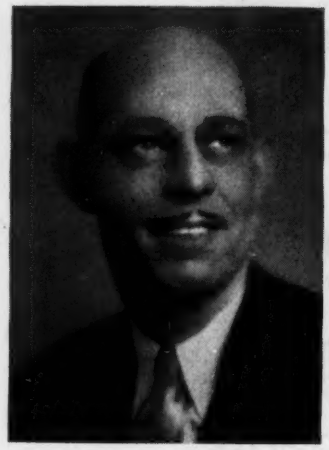
* Company Members.
** Sustaining Members

Cite A.F.A. Vocational Booklet

Included in *The Hundred Best,* the A.F.A. publication THE FOUNDRY IS A GOOD PLACE TO WORK has been cited as an outstanding piece of vocational guidance literature by Science Research Associates.

Widely distributed, THE FOUNDRY IS A GOOD PLACE TO WORK is available from A.F.A. headquarters for foundry educational and recruiting work. The booklet is free to chapter educational committees, educational institutions, libraries, employment bureaus, and veterans offices; there is a small charge to industrial plants.

Chapter Officers and Directors



W. D. Emmett
Los Angeles Steel Casting Co.
Los Angeles
Director
Southern California Chapter

A. W. Stolzenburg
Aluminum Co. of America
Detroit
Vice-Chairman
Detroit Chapter

C. E. Rothweiler
Hickman, Williams & Co.
St. Louis
Director
St. Louis District Chapter

J. S. Vanick
International Nickel Co.
New York
Director
Metropolitan Chapter

F. G. Vargas
2a. Privada C. Beistegui No. 14
Mexico, D. F.
Treasurer
Mexico City Chapter

G. E. Garvey
City Pattern & Foundry Co., Inc.
South Bend, Ind.
Director
Michiana Chapter

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Texas Foundries, Inc.
Lufkin, Texas
Director
Texas Chapter

H. G. Hetzler
Hetzler Foundries, Inc.
Rochester, N.Y.
Director
Rochester Chapter

E. R. Frost
E. R. Frost Co.
Minneapolis, Minn.
Director
Twin City Chapter

E. G. White
Crouse-Hinds Corp.
Syracuse, N.Y.
Director
Central New York Chapter

D. E. Krause
Gray Iron Research Institute
Columbus, Ohio
Secretary
Central Ohio Chapter

J. G. Hunt
Dominion Engineering Works, Ltd.
Montreal, Que.
Secretary
E. Canada & Newfoundland Chapter

FOUNDRY FIRM *Facts*

The Davies and Thomas foundry, Catasauqua, Pa., will operate under the new name of **Davies and Thomas, Inc.** James T. Duffy, Jr., has assumed the position of Chairman of the Board and Treasurer. Other officers are: Norman Esibill, president; Herbert Cohen, secretary; Fred Walker, comptroller; Milton Knauss, plant manager; and Charles Leahy, foundry superintendent.

Wheelco Instruments Company has opened a branch office in Cleveland which is located at 4501 Prospect Ave. The Washington, D.C., office has moved to new quarters at 2285 Rhode Island Ave.

A wartime government plant suitable for steel fabrication or metal stamping, with a total of 354,000 sq ft of building area on a tract containing 24 acres in Harrisburg, Pa., will be auctioned April 22. For more complete information write **Joseph P. Day, Inc.,** 405 Lexington Ave., New York.

The highest-honor safety award was recently presented to the employees and management of the steel foundry, **Link-Belt Co.,** Pershing Road plant, Chicago, from the Steel Founders' Society of America, under Group 2. The participating foundries were divided into four groups on basis of their average monthly man-hours of exposure. Group 2 covered 21,000 to 35,000 man-hours.

American Brake Shoe Company's two non-ferrous foundries recently completed at Niles, Ohio, and Meadville, Pa., are now in operation. The Meadville plant will produce bronze bearings and castings. The Niles, Ohio, foundry will manufacture railroad journal bearings.

Damage estimated at more than $50,000 was caused by a fire at the **Ridge Foundry,** San Leandro, Calif.

Queen City Foundry, Buffalo, N.Y., will spend $10,000 to enlarge its foundry at 391 Norfolk Ave.

In line with their general program of postwar reconversion and expansion the **Jones & Laughlin Steel Corp.** is adding to the capacity of its Otis Works. Included in this program is a new open hearth furnace designed to furnish additional steel making capacity for their mills. This furnace is of the basic open hearth type, with a rated capacity of 175 net tons. The furnace is being engineered and constructed by Loftus Engineering Corp., Pittsburgh, Pa.

Metal Goods Corp., 817-17th St., Denver, Colo., have been appointed distributors of primary nickel for alloying purposes and mill forms of monel, nickel and inconel, in the states of Colorado, Wyoming and New Mexico.

Johnston & Jennings Co., Chicago, sold its foundry at 1030 W. 38th St. to Joslyn Mfg. & Supply Co., Chicago, for $80,000 and then leased it back for five years. The foundry includes 17,500 sq. ft. of floor space.

Fire of an undetermined origin caused $6,000-$7,000 damage to the **Liberty Brass & Foundry Co.,** San Francisco.

The **Air Reduction Company** has formed a new wholly owned subsidiary, the Air Reduction Pacific Company. The new subsidiary has been formed in recognition of the increasing importance and continuing growth of west coast industry. H. P. Etter will be president and director of the company. Other directors will be: C. D'W. Gibson, G. E. Hawkins, J. A. Hill, C. G. Andrew and W. C. Keeley, who will also serve as chairman of the board.

Aerial view of the National Bearing Div., American Brake Shoe Co., Meadville, Pa., plant that is producing bronze bearings.

The **Mueller Bros. Pattern Works, Inc.,** Waukesha, Wis., was currently written up in the Waukesha *Freeman* as one of the principal industries located in that city.

An interior view of the Mueller Bros. Pattern Works with a few samples of their work.

The Ordill Foundry Co. has leased 18,180 sq. ft. of space in the Illinois Ordnance Plant. The foundry will produce iron castings for small production machinery. The Ordill Foundry Co. is an affiliate of the Excelsior Foundry Co., Belleville, Ill.

Joseph P. Bauer and Lester Benson have acquired the **Metals & Alloys Specialties Co.,** Buffalo, through purchase of stock from the estate of Thomas S. Hemenway, founder of the 31-year old concern.

Kuhns Bros. Foundry, Dayton, Ohio, are constructing a new foundry addition which will increase the floor space of the concern some 20,000 sq ft and provide for mechanizing a section of the foundry. Modern locker room facilities will also be installed.

New manufacturing and laboratory facilities have been placed in operation by the **Acheson Colloids Corp.,** Port Huron, Mich. This is the latest in a long-range expansion program.

Plans for the construction this spring of a 2 million dollar foundry by the Sealed Power Corp., Muskegon, were announced recently. The first unit of the new building is expected to be placed in operation by January 1, 1949. The foundry will employ 125-150 persons.

The American Boiler & Foundry Co., Milan, Mich., which was destroyed by fire Feb. 3, is under reconstruction. The building will approximate the old structure in size—200 ft long by 115 ft wide with 22,000 ft of floor area.

FOUNDRY *Personalities*

M. G. Sternberg has been elected president, Continental Foundry & Machine Co., Pittsburgh, Pa. Mr. Sternberg formerly was executive vice-president. **H. A. Forsberg** has been elected to one of the vice-presidencies. Both Messrs. Sternberg and Forsberg have been active in the A.F.A. Chicago chapter.

Charles S. Munson, formerly president, Air Reduction Co., Inc., New York, has been elected chairman of the executive committee. He is succeeded by **John A. Hill. William C. Keeley,** formerly vice-president, was elected chairman of the newly created finance committee. **C. E. Adams** remains chairman of the board.

C. A. Pattison has been elected president, Peoria Malleable Castings Co., Peoria, Ill. Other officers elected at the annual meeting of the company are: **Wm. Scott Roby,** vice-president and treasurer and **L. E. Roby, Jr.,** vice-president and secretary.

Walter E. Remmers was recently elected president, Electro Metallurgical Co., New York. Mr. Remmers also was elected president, Electro Metallurgical Co. of Canada, Ltd., and other associated metallurgical units of Union Carbide & Carbon Corp.

Associated with the company since 1936, he has been vice-president and director since April, 1945. He is a graduate of Missouri School of Mines and Metallurgy.

H. H. Holland has been appointed works manager of the Radford (Va.) Plant of Lynchburg Foundry Co., effective February 1, succeeding R. S. Dower, retired due to ill health. Mr. Holland has been connected with the Lynchburg firm for the past 10 years and formerly served as plant manager and acting manager at the Radford Works.

Frederick K. Vial, vice-president and director, Griffin Wheel Co., Chicago, retired January 1. He is an honorary life member of A.F.A. having received the J. H. Whiting Gold Medal in 1940 for his outstanding work in the development of cupola processes. In 1902 he joined Griffin Wheel Co. as mechanical engineer and in 1906 he became chief engineer, in charge of manufacturing operations, cupola mixtures, wheel design, plant construction, research work and many other responsibilities for all plants of the company. Later he was elected vice-president and in 1917 he was made a director of the company.

For many years he served on various technical committees and was very active in the American Foundrymen's Association. On the formation of the Association of Manufacturers of Chilled Car Wheels in 1908. Mr. Vial was selected as consulting engineer, and later as vice-president, which positions he retained to retirement.

Howard J. Elgin and **Charles H. Roper** have been elected vice-presidents, Steel Sales Corp., Chicago. Mr. Elgin is a graduate of the University of Illinois and came to Steel Sales in 1935. He served in various capacities and was named manager, monel and nickel sales, in 1944.

Mr. Roper attended Furman University and Clemson College. He became associated with Steel Sales in 1927 serving as salesman in the Milwaukee and Minneapolis territories. Since it was opened in 1934, he has been manager of the St. Louis branch office and warehouse.

Appointment of four vice-presidents for Air Reduction Pacific Co., the new subsidiary of Air Reduction Co., Inc., has been announced. The vice-presidents are: **L. A. Hamilton, E. W. MacCorkle, Jr., H. W. Saunders** and **H. A. Hoth.**

Mr. Hamilton will be in charge of the Seattle office. He is a graduate of Rice Institute and began work with Air Reduction in 1930.

The Portland office will be in the hands of Mr. MacCorkle who is a Washington and Lee, and Cornell graduate. He held the rank of commander during World War II.

Mr. Saunders, who has been with the company 30 years, will have charge of the San Francisco office.

The Los Angeles district office will be in charge of Mr. Hoth who has been with the company 12 years.

Ralph L. Wilcox has been elected vice-president in charge of industrial sales and engineering, Gerity-Michigan Corp., Adrian, Mich. **W. Waite Broughton,** former production manager, Trico Products Corp., Buffalo, N.Y., has been appointed to succeed Mr. Wilcox as Detroit divisional manager.

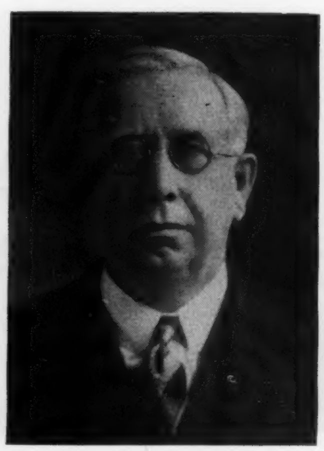
Mr. Wilcox had been general manager of the Detroit division since 1946. A metallurgical engineer, he served as consultant to the WPB.

Mr. Broughton had been associated with National Lead Co. for 8 years prior to his service with Trico.

H. H. Holland

H. A. Forsberg

F. K. Vial



E. G. Schmidt

C. H. Cousineau

W. B. McFerrin

W. E. Sicha

G. R. Gardner

Emil G. Schmidt has been made foundry superintendent, Studebaker Corp., South Bend, Ind. Mr. Schmidt was for many years in charge of foundry operations for International Harvester Co. He was assistant foundry superintendent at the company's Rock Island plant for four years, and later became superintendent of company foundries in Indianapolis and Louisville. He is a graduate of Dartmouth College where he obtained his Bachelor and Master of Science degrees.

G. R. Gardner, H. Y. Hunsicker and **W. E. Sicha** have been advanced to assistant chiefs, Cleveland Research Division, Aluminum Co. of America.

G. R. Gardner started with the Aluminum Company in 1939 in the production department, castings division, and became a member of the Aluminum Research Laboratories 5 years later. Mr. Gardner has been responsible for the organization of an entirely new department and field of research in Cleveland which is concerned with sands, mold and core materials, and other non-metallic substances used in the foundry. He is active in the A.F.A., has presented a number of technical papers, and is on several national committees of the Association.

H. Y. Hunsicker became associated with the Cleveland Research Division in 1936 and directs permanent mold casting research. Active in several technical societies, he has written many technical papers including one on solidification of aluminum presented at the 1947 Detroit A.F.A. Convention.

W. E. Sicha was initially employed with the Aluminum Company in 1928 in the production department and became a member of the Cleveland Research Division in 1943 in charge of sand casting research. He is a member of A.F.A. and has given numerous technical papers and lectures.

W. B. McFerrin was recently named district manager of service, Electro Metallurgical Co., with headquarters in Detroit. Other appointments include: **Russell Franks,** chief metallurgist, with headquarters in Pittsburgh, and **J. N. Ludwig, Jr.,** with headquarters in Pittsburgh: **R. J. Portman,** Chicago; and **F. W. Hanson,** New York, all named division service managers.

Western Michigan Chapter Chairman **Chas. H. Cousineau** has accepted a position with Hill & Griffith Co., Cincinnati, Ohio, as service manager. He was formerly metallurgist with West Michigan Steel Foundry Co., Muskegon, Mich.

Dr. J. V. Pennington, Houston consulting engineer, has accepted appointment as associate director, Southwest Research Institute, San Antonio and Houston.

The National Engineering Co., Chicago, has made the following changes and additions to its sales staff: **W. E. Jones, E. C. Troy, Frank Jensen** and **Fred W. Fuller.**

W. E. Jones, who for the last four years has been the representative in Eastern Pennsylvania, New Jersey, Delaware and Maryland with headquarters in Philadelphia, will be transferred to Detroit to handle the state of Michigan.

E. C. Troy, formerly vice-president in charge of research development, Dodge Steel Co., Philadelphia, and Philadelphia Chapter Chairman, will act as service and sales engineer in the territory serviced by Mr. Jones.

Frank Jensen, who has been the company's representative in the state of Michigan and Ontario, Canada, since 1936, has been advanced to district manager, north central division.

Fred W. Fuller, Central Ohio Chapter Vice-Chairman, and who has been foundry engineer in the state of Ohio, has been made special agent for the northern section of Ohio.

(Continued on Page 82)

Frank Jensen

W. E. Jones

F. W. Fuller

E. C. Troy

CHAPTER ACTIVITIES NEWS

Cincinnati District

C. H. Fredricks
Cincinnati Milling Machine Co.
Chapter Reporter

LEADING OFF with the statement that employees should not be expected to take the same interest in the business as those who represent management, R. L. Lee, public relations department, General Motors Corp., Detroit, gave an instructive and educational discourse on "Man to Man on the Job."

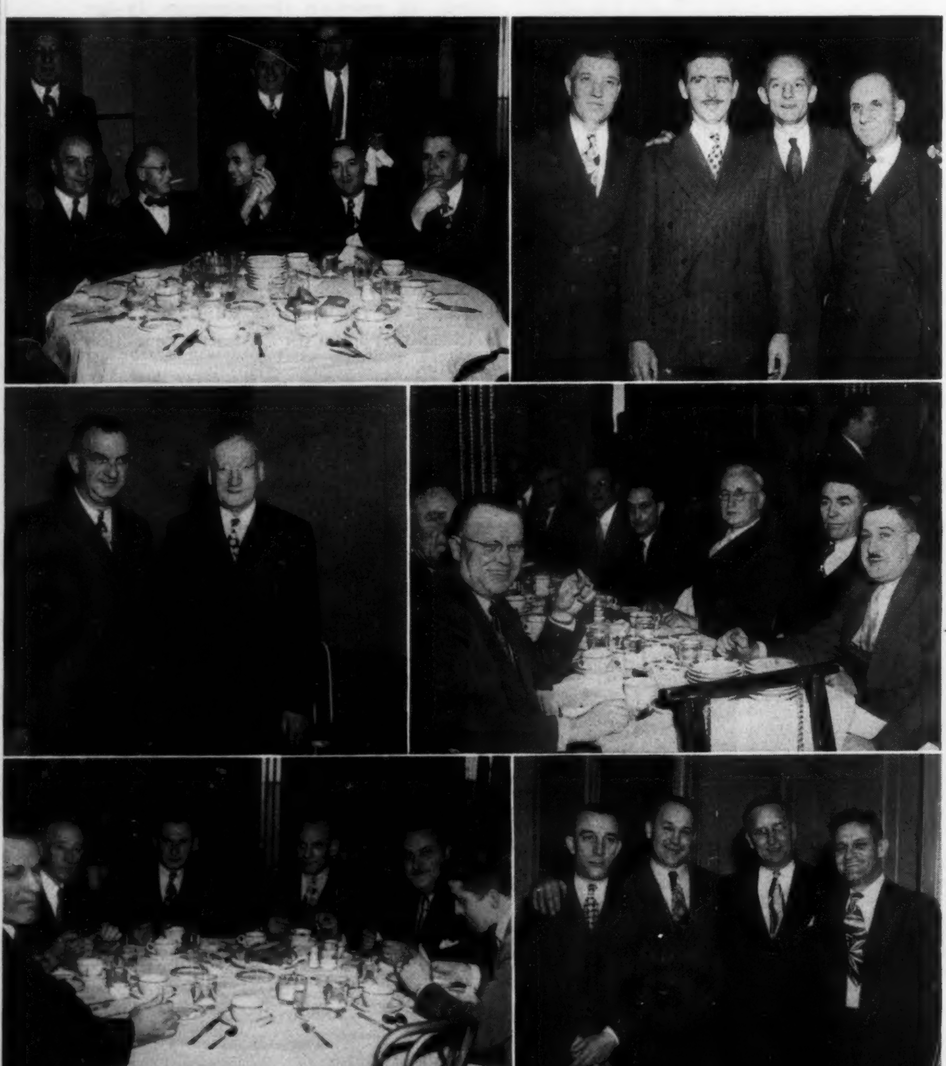
One hundred and fifty members and guests attended the meeting held at the Engineering Society Headquarters building, Cincinnati. Chapter Chairman Edgar J. Kihn, general foreman, Cincinnati Milling Machine Co., Cincinnati, was the presiding officer. The chapter held its meeting on January 12.

Mr. Lee also pointed out that it is imperative to provide means for those employees who wish to make a name for themselves on their present jobs and should be given every opportunity to do so. Giving the employee a chance to see the finished product is necessary, too, as it enables him to realize the importance of his individual efforts.

Employees should be imbued with the importance of the foundry industry as the foundation for all industries in that it is the beginning of practically everything that is made, Mr. Lee said.

The speaker urged all employers to knock the props from under rank consciousness. If the job is necessary to the production of castings, regardless of how menial, each person should be respected for the job he is doing and is therefore entitled to recognition, he added.

The candid camera of John Bing, A. P. Green Fire Brick Co., Milwaukee, was working overtime at the Wisconsin chapter's Christmas party held December 12 at the Schroeder Hotel.



Michiana

S. F. Krzeszewski
American Wheelabrator & Equip. Corp.
Publicity Chairman

ON JANUARY 6 the Michiana chapter assembled to hear B. P. Mulcahy, consulting engineer, Indianapolis, speak on "Cupola Operation." He analyzed the critical shortage of pig iron and coke in the gray iron industry, and their effect upon present day operations.

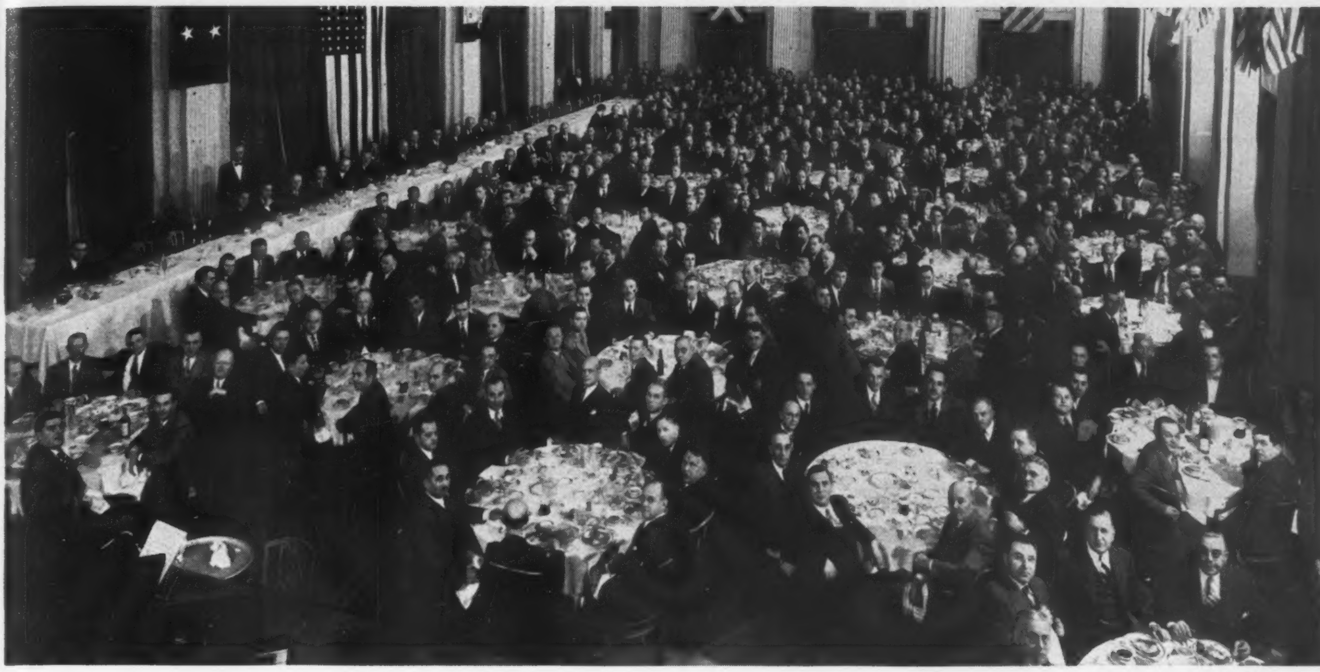
Presenting analyses of current coke, Mr. Mulcahy informed his audience of the deficiencies in coke as compared to the pre-war products. He also explained correct practices in cupola operation, and outlined the advantages resulting in conservation of coke.

Mr. Mulcahy delved into all of the details pertaining to proper cupola operation, the charge, the melting, the chemistry of iron, and the care of the cupola. He demonstrated such a thorough and complete knowledge of his subject, that many members of the chapter availed themselves of the opportunity to discuss their individual cupola problems with him after the close of the meeting.

Twin City

O. J. Myers
Werner G. Smith Co.
Chapter Reporter

APPROXIMATELY ONE HUNDRED and fifty foundrymen were guests of the Minneapolis Moline Power Imple-



The annual Christmas party of the Philadelphia chapter was held at the Benjamin Franklin Hotel on the evening of December 16 and was attended by 471 members and guests. Entertainment followed the dinner.

ment Co., Hopkins, Minn., on January 8 and were treated to a full afternoon and evening of entertainment. This included a plant visitation, dinner and a timely speech by C. R. Simmons, sales engineer, Durez Plastics & Chemical, Inc., North Tonawanda, N.Y.

Mr. Simmons discussed the role of plastics in patternmaking and dealt with the liquid phenolic type of plastic and actually cast a small pattern during his discourse.

For large patterns, approximately 4 per cent acid accelerator is necessary. The liquid resin and accelerator are mixed together, and the plaster mold cavity is filled with this material. The mold is allowed to stand for a few hours and then baked at 140 F for 4 hours.

Host to the January 8 meeting of the Twin City chapter was the Minneapolis Moline Power Implement Co. These members are looking over a company product which requires a number of castings.

(Photo courtesy Pufahl Foundry, Inc.)

The phenolic resin may be poured in wood or glass molds instead of plaster. Mr. Simmons cautioned against the use of any metal molds other than lead, because of the possible acid accelerator reaction on the metal. Plaster molds must be coated with a special plastic paint and then waxed.

Advantages of plastic patterns include: (1) low initial cost; (2) easy duplication; and (3) smoother mold surface more easily produced; (4) Ease of patching. Plastic patterns with heavy masses or thin fins were not recommended.

Northeastern Ohio

R. H. Herrmann
Penton Publishing Co.
Chapter Reporter

RISERS FEED CASTINGS only when the metal is at freezing temperature and usually are only 20 per cent efficient and seldom as much as 40 per cent efficient. Insulation and the use of exothermic topping compounds, however, have made some risers 90 per cent efficient.

These remarks were made when

Fred G. Sefing, International Nickel Co., Inc., New York, addressed 224 members and guests of the chapter at the Cleveland Club, Cleveland, January 8. Mr. Sefing had as his topic "Casting Soundness as Affected by Gating, Risering and Gas Porosity."

The speaker stated that the one underlying principle that holds true for producing sound castings from all metals is controlled progressive solidification. The gating, risering and pouring of castings should be done in such a manner as to fulfill that principle. He added that it is a fact that the thinnest casting sections and the coldest metal freeze first. These facts should be considered when gating and risering castings. According to Mr. Sefing, the same principles of gating and risering apply in all metals—it is only the degree that differs.

Mr. Sefing advocated fast and quiet pouring by using many thin, wide gates to get metal into the mold quickly and with little washing effect. Slow pouring regardless of the metal temperature, he said, is the same as pouring cold-metal

Eastern Canada & Newfoundland
H. Louette
Warden King Ltd.
Publicity Co-Chairman

DEVIATING from the regular type of technical meeting the Eastern Canada and Newfoundland chapter held a Quiz Night program at its January 9 meeting at the Mount Royal Hotel, Montreal.

The technical chairman was

James Grieve, Dominion Engineering Works, Lachine, Que., (at the microphone) asks a question of one of the experts, W. T. Shute, Canadian Car & Foundry Co., Ltd., Montreal, (standing) during Eastern Canada & Newfoundland chapter's Quiz Night.

Cincinnati District chapter Christmas party was held December 13 at the Netherland Plaza Hotel, Cincinnati, with approximately 500 attending.

Chapter Meetings

MARCH 17
TOLEDO
Toledo Yacht Club
MOVIE

MARCH 18
CANTON DISTRICT
Portage Hotel, Akron
E. H. TAYLOR
F. E. Myers & Bro. Co.
QUIZ NIGHT

DETROIT
Rackham Educational Memorial
F. G. STEINEBACH
Penton Publishing Co.
"Present Status of Foundry Industry"
W. N. WITHERIDGE
General Motors Corp.
"Control Foundry Atmosphere"
A. S. LUNDY
Claude B. Schneible Co.
"Savings in Foundry Ventilation and Heating"

OREGON
Heathman Hotel, Portland
A. G. ZIMA
International Nickel Co., Inc.
"Modern Developments in the Foundry Industry"

MARCH 19
BIRMINGHAM DISTRICT
Tutwiler Hotel, Birmingham
QUIZ PROGRAM

CHATTANOOGA
N. J. DUNBECK
Eastern Clay Products, Inc.
"Synthetic Sand Practice"

TEXAS
Texas State Hotel, Houston
E. E. BALLARD
Lester B. Knight & Associates, Inc.
"Foundry Modernization"

MEXICO CITY
Casa Jalisco, San Cosme, Mexico
F. A. GITZEN
Delta Oil Products Co.
"Sand Binders"

MARCH 22
CENTRAL OHIO
Chittenden Hotel, Columbus
W. B. MCFERRIN
Electro Metallurgical Co.
"Casting Defects"

NORTHWESTERN PENNSYLVANIA
Moose Club, Erie
O. J. MYERS
Werner G. Smith Co.
"Core Sands and Binders"

MARCH 23
CENTRAL MICHIGAN
Schuler Hotel, Marshall
G. E. TUBICH
Michigan Bureau of Industrial Health
"Foundry Health Hazards"

TIMBERLINE
Cunninghams Restaurant, Denver
L. P. ROBINSON
Werner G. Smith Co.
"Core Room Problems"

MARCH 25
ONTARIO
Royal Connaught Hotel, Hamilton
ROUND TABLE DISCUSSION

MARCH 26
CHESAPEAKE
Engineers Club, Baltimore
L. W. EASTWOOD
Battelle Memorial Institute
"Casting Unsoundness Caused by Gas Evolution"

TRI-STATE
Mayo Hotel, Tulsa
H. L. SMITH
American Smelting & Refining Co.
"Aluminum & Magnesium Foundry Practice"

APRIL 1
TWIN CITY
Covered Wagon, Minneapolis
E. V. BLACKMUN
Aluminum Company of America
"Aluminum Foundry Practice"

APRIL 2
WESTERN NEW YORK
Boland Post, American Legion, Buffalo
SAND CASTER BIRTHDAY PARTY

APRIL 5
CENTRAL ILLINOIS
Jefferson Hotel, Peoria
L. L. CLARK
General Motors Corp.
"Cupola Operation"

CENTRAL INDIANA
Athenaeum, Indianapolis
W. B. MCFERRIN
Electro Metallurgical Co.
"Gray Iron Castings Defects"

METROPOLITAN
Essex House, Newark, N.J.
C. R. SIMMONS
Durez Plastics & Chemicals, Inc.
"Plastic Patternmaking"
G. LEDERMANN
Ledermann & Baessler
"Rigging for Core Blowing"

CHICAGO
Chicago Bar Association
C. R. HOOK
American Rolling Mill
"Taking the Mystery Out of Business."

APRIL 6
MICHIANA
Spaulding Hotel, Michigan City
J. A. RASSENFOSS
American Steel Foundries
"Fundamentals of Sand Behavior"

APRIL 8
NORTHEASTERN OHIO
C. J. FREUND
University of Detroit
"Why a Boy Should Go Into the Foundry"

ST. LOUIS DISTRICT
York Hotel, St. Louis
W. M. BARR
Union Pacific Railroad
"Casting Inspection"

APRIL 9
CENTRAL NEW YORK
Onondaga Hotel, Syracuse
NATIONAL OFFICERS NIGHT
A.F.A. National President
MAX KUNIANSKY
A.F.A. Secretary-Treasurer
WM. W. MALONEY
T. W. CURRY
Lynchburg Foundry Co.
"Chemically Bonded Sands"

E. CANADA & NEWFOUNDLAND
Mount Royal Hotel, Montreal
H. C. WINTE
Worthington Pump & Machinery Co.
"Gates and Risers to Make Sound Castings"

PHILADELPHIA
Engineers Club, Philadelphia
N. J. DUNBECK
Eastern Clay Products, Inc.
"Foundry Sands"

SOUTHERN CALIFORNIA
Rodger Young Auditorium, Los Angeles
K. L. CLARK
International Nickel Co., Inc.
"Some Variables in the Elements of Foundry Practice"

WISCONSIN
Hotel Schroeder, Milwaukee
SECTIONAL MEETINGS

APRIL 12
CINCINNATI DISTRICT
LESTER B. KNIGHT
Lester B. Knight & Associates, Inc.
"Modernization of Small Foundries"

WESTERN MICHIGAN
Schuler Hotel, Grand Haven
U. S. SULLIVAN
Caterpillar Tractor Co.
"Quality Control—Inspection Methods"

APRIL 13
ROCHESTER
Seneca Hotel
C. R. SIMMONS
Durez Plastic & Chemicals, Inc.
"Plastic Patternmaking"

C. A. Sanders (left), American Colloid Co., Chicago, was the technical speaker at the Timberline chapter meeting held in November. Others in the photograph are Chapter Chairman J. L. Higson, Western Foundry Co. (center) and Chapter Secretary C. E. Stull, Manufacturers Foundry Corp., both of Denver. Mr. Sanders spoke on control of foundry sands.

James Grieve, Dominion Engineering Works, Lachine, Que. The panel of experts included: E. C. Winsborrow, Shawinigan Foundries Ltd., Shawinigan Falls, Que.; G. Ewing Tait, Dominion Engineering Works, Montreal; J. W. Birks, Crane Ltd., Westmont; G. W. McLeary, Shawinigan Chemicals Ltd., Stainless Steel Div., Shawinigan Falls; W. T. Shute and John McCallum, Canadian Car & Foundry Ltd., Westmont; William Forrest and Marc Chicoine, Robert Mitchell Co., Ltd., Montreal; and H. W. Bennett, Dominion Engineering Works.

Referees were H. Louette and A. E. Cartwright, Crane Ltd., who awarded prizes to W. T. Shute and C. Rowe of Crane, Ltd., for asking questions which the panel could not satisfactorily answer.

Northern California

John Bermingham
E. F. Houghton & Co.
Publicity Chairman

THE CHAPTER HELD an outstanding meeting on January 9 at the Engineers Club with I. M. White, chief engineer, Pelton Water Wheel Co., San Francisco, as the main speaker. He explained the manner in which his firm is making pumps for the Grand Coulee Dam.

Most of the figures quoted by Mr. White were difficult to conceive but by using slides to illustrate the work these pumps must do, some idea of the size involved could be readily obtained. Casting sizes of 16 to 17 ft in diameter, weights of 36,000 to 44,000 lb per casting, and pump rotors weighing 70,000 lb seem to be normal figures for the largest pumps in the world. It was interesting to hear Mr. White tell of some of the design problems and discuss the tests that were made with a pump built to one thirteenth scale. Many members were interested in the rotor design, and as Mr. White thoughtfully brought along the rotor of the test pump, a close inspection was possible. It was generally believed that the large casting offered many interesting problems to the foundry industry, and although the pumps are almost entirely steel, the iron and brass men were equally interested.

Pland's Broadway was the scene for the December meeting of the chapter and Clarence R. Strock, process service engineer, Linde Air Products Co., San Francisco, gave the technical address on "Powder Cutting." He explained that this is a new development in oxyacetylene cutting adaptable to foundry work both in the preparation of raw materials and in the processing of the finished product. Slides were shown that brought out that an additive being present at the point of cutting enabled the operator to obtain smooth and even cut surfaces. The powder is applied through the torch which is so constructed that the operation of the equipment for pow-

Officers and directors of the newly formed Eastern New York chapter: seated (starting left) Hans G. Hinrichs, Hillsdale Foundry Corp., Hillsdale; Vice-Chairman Alexander C. Andrew, American Locomotive Co., Schenectady; Chairman, C. E. Killmer, Sr., Swan-Finch Oil Corp., Albany; Secretary-Treasurer J. A. Wettergreen, General Electric Co., Schenectady; and J. H. Wheeler, Wheeler Bros. Brass Founders Inc., Troy. Standing (starting left) P. C. Wilson, James Hunter Machine Co., North Adams, Mass.; B. F. Sweet, Noble & Wood Machine Co., Hoosick Falls; K. F. Echard, Eddy Valve Co., Waterford; R. B. De Varennes, Rensselaer Valve Co., Troy; Leonard Wilson; and C. L. Richards, Adirondack Foundries & Steel Inc., Watervliet.

der cutting is relatively simple. High chrome steels do not present any problem when this method of oxy-acetylene flame cutting is used.

Western Michigan

D. A. Paull
Sealed Power Corp.
Chapter Reporter

THE MONTHLY MEETING of the Western Michigan chapter was held January 12 at the Schuler Hotel, Grand Haven, with 109 members and guests in attendance. Clyde A. Sanders, engineer, American Colloid Co., Chicago, was the speaker and his subject was "Modern Progress in Foundry Sand Practice."

No. Illinois-So. Wisconsin

C. L. Dahlquist
Greenlee Bros. & Co.
Technical Secretary

BEGINNING WITH A BRIEF REVIEW of the art of molding which dates back to early Chinese history, E. T. Kindt, Kindt-Collins Co., Cleveland, discussed "The Pattern Industry: Past, Present and Future Trend" at the January 13 meeting of the Northern Illinois-Southern Wisconsin chapter held in the Faust Hotel, Rockford, Ill.

Mr. Kindt dealt with several subjects relative to patternmaking and urged foundrymen to (1) stimulate interest in patternmaking; (2) select proper equipment and plan office layout; (3) investigate the principles employed in figuring wood and metal pattern costs; (4) standardize pattern supplies; (5) make permanent molds and (6) study the applications of plastics, ceramics and plaster being used more and more as pattern materials.

The speaker pointed out that one of the biggest assets to any pattern shop is to have a well trained pattern engineer who is capable of figuring costs on a scientific basis. He emphasized that too many pattern men are not sufficiently cost conscious. He cited, as an example, a six man pattern shop where the two owning partners had an annual profit of $2,024 out of a $39,300 business. Cost records should be kept on every item in order to establish the proper operating figure, Mr. Kindt stated.

Philadelphia

Jack Furey
Swan-Finch Oil Corp.
Publicity Chairman

THE PRESIDING OFFICER at the January 9 meeting of the Philadelphia chapter was Chapter Chairman E. C. Troy, vice-president in charge of research, Dodge Steel Co., Philadelphia. Following the dinner, the meeting was divided into three sections which discussed gray iron, steel and non-ferrous problems.

The cast iron group was under the leadership of George Bradshaw, master molder, Philadelphia Navy Yard with B. A. Miller, chief metallurgist, Cramp Brass & Iron Found-

On January 5 the Chicago chapter held sectional meetings that attracted a good crowd. Above (starting left) A. W. Gregg, Whiting Corp., Harvey, Ill.; Chapter President F. B. Skeates, Link-Belt Co., Chicago; and Chapter Director L. H. Hahn, Sivyer Steel Casting Co., Chicago. Below—some of the foundrymen who heard Claude Jeter, Ford Motor Co., Dearborn, Mich., speak.

Top—Handing out Christmas presents at the Timberline chapter party held December 16. Below—Publicity Chairman J. W. Creamer, Western Foundry Co., Denver, opening the "prize" present of the evening.

ries Div., Baldwin Locomotive Works as co-leader. This session was devoted to gating problems, cupola control, cleaning room problems, making castings without pig iron and making synthetic pig iron to overcome present shortages.

Jack Csaklos, vice-president in charge of operations, Crucible Steel Casting Co., Lansdowne, Pa., and Clyde Jenni, metallurgist, General Steel Castings Co., Philadelphia, acted as leader and co-leader, respectively, of the steel section. Core washes, casting defects and the use of various types of core blowing machines were discussed.

The non-ferrous panel had as its leader J. Roberts, American Manganese Bronze Co., Philadelphia, and D. Bryden, Philadelphia Brass & Bronze Co., Philadelphia, acted as co-leader. The discussion covered molding, core making and cleaning. The subject of radiographic inspection of bronze castings developed into an interesting session. The conclusion was reached that the method has practical value in the production of bronze castings. It was declared that defects observed in radiography can be directly related to incorrect foundry techniques.

New England

Merton A. Hosmer
Hunt-Spiller Mfg. Corp.
Association Reporter

Highlight of the January 14 meeting was the election of officers for the New England Foundrymen's Association. Officers named to serve the group were: *President,* A. F. Dockry, H. & B. American Machine Co., Pawtucket, R.I.; *Vice-President,* F. M. Fitzgerald, Draper Corp., Hopedale, Mass.; *Treasurer,* A. W. Gibby, East Boston; and *Secretary,* E. F. Stockwell, Barbour-Stockwell Co., Cambridge, Mass. The *Executive Committee* is composed of: F. M. Fitzgerald, *Chairman;* T. I. Curtin, Waltham Foundry Co., Waltham, Mass.; R. C. Walker, Whitin Machine Co., Whitinsville, Mass.; F. R. Elliott, Westinghouse Electric Corp., Springfield, Mass.; J. B. Stazinski, General Electric Co., Lynn, Mass.; and C. A. Reed, Cambridge.

After election of officers, a dinner was served followed by a special program of entertainment.

Rochester

G. M. Etherington
Gleason Works
Chapter Reporter

A very timely address was given by R. G. McElwee, Vanadium Corp. of America, Detroit, when he addressed the Rochester chapter on January 13 at the Seneca Hotel, Rochester. The subject was "Operation of the Cupola with Present Day Material Shortages."

The speaker said that foundrymen are no longer content to load iron and coke through the charging door and take what comes out the spout. Instead, foundrymen insist on ever increasing control of their iron, and through the knowledge gained by cupola research, foundrymen are better able to achieve the control so essential in a modern foundry.

The necessity for proper bed height and coke splits was emphasized. The speaker also stressed the need for iron of the proper analysis.

(*Continued on Page 76*)

FOUNDRY *Literature*

Readers interested in obtaining additional information on items described in Foundry Literature should send requests to Reader Service, American Foundryman, 222 W. Adams St., Chicago 6, Ill. Refer to the items by means of the convenient code numbers.

MR100—The 16-mm motion picture "New Foundry Horizons," sponsored by National Engineering Co., is now available, without charge or obligation, for group showings to any audience interested in the foundry industry. This film is completely titled (not sound) and needs no accompanying lecture during its 40-minute projection. Subjects included in the film are: core blowers, sand handling and distribution, molding, semi-continuous mold conveyors, shakeout, cleaning and annealing.

MR101—A 4-page booklet describing the style M vibrex screen has been issued by Robins Conveyors Division, Hewitt-Robins Inc. Briefed for quick reading it is an explanation of the 2-bearing circle-throw principle employed in this screen, which has adjustable stroke and easy angle-adjustment. The booklet also tells how the screen can be floor-mounted or suspended.

MR102—A three-color, 30-page bulletin relating to electric trucks manufactured by Yale and Towne Mfg. Co. has just been released. Each of the seven types of trucks are described and illustrated in detail. Recommended uses, capacity, weight, battery characteristics, speeds, dimensions, electric characteristics, mechanical characteristics and general characteristics are given for each truck. The seven types cataloged are (1) the tilting-fork truck, (2) the non-tilting fork truck, (3) the low-lift pallet truck, (4) the low-lift platform truck, (5) the high-lift platform truck, (6) the electric tractor, and (7) the electric tinplate truck.

MR103—Dings Magnetic Separator Co., has issued a bulletin which describes operation of its laboratory in solving separation problems in many industries. Purpose of laboratory, whose service is free, is to analyze materials to determine if, and how best, they can be magnetically separated, and to develop new and improved separators. Procedure to be followed in arranging for product tests is described.

MR104—U. S. Reduction Co. is furnishing free a ring binder that will provide convenient storage space for issues of "USCO Newscasting," monthly digest of news about aluminum distributed to the foundry field by the above firm. Binders are maroon simulated leather, embossed with aluminum ink.

MR105—"Nickel Alloys in Railway Equipment" is a revised 32-page booklet with attractive illustrations and data describing the uses of stainless steels, alloy steels, alloy cast irons and bronzes, and other alloys containing nickel in the development of modern rail transportation. International Nickel Co. produced this booklet.

MR106—A 60 page booklet has been released by Battelle Memorial Institute entitled "Research in Action." The booklet describes the men, equipment and methods used in its numerous research projects. It takes you through the numerous divisions of the Institute pictorially and shows many of the projects being carried on. Some of the historical background of the Institute is given along with a list of industrial sponsors.

MR107—The sixth edition of "Manhattan Rubber Products for Industry," a condensed catalog of mechanical rubber goods, has been completed by the Manhattan Rubber Div., Raybestos-Manhattan Inc. Described in this catalog are many mechanical rubber products and special items manufactured by Manhattan Rubber. Particular emphasis is given transmission and conveyor belting, V-belts, hose, engineered molded products, abrasive wheels.

MR108—An unusually thorough and authoritative presentation on problems in die casting, and on the characteristics and applications of the various die casting alloys, has been issued by Federated Metals Div., American Smelting & Refining Co. Titled "Die Metal for Better Die Castings," the brochure is a highly informative exposition on the nature of die casting, die casting processes, the selection of alloys, general metallurgy of the alloys, effects of impurities, and the melting of the metals.

MR109—Speedy, effective and economical patching of cracks, ruts and shallow holes in concrete floors is shown and described in a leaflet put out by the makers of Smooth-On No. 7B quick floor patch iron cement. The leaflet explains the simplicity of application, its characteristic of expanding slightly as it hardens, so as to wedge finished patches tightly in place and its quick hardening feature which permits full traffic in the morning on floors patched the preceding evening. The Smooth-On Mfg. Co. released the leaflet.

MR110—Practical methods for increasing production, improving workmanship and reducing costs with light portable grinding equipment are described in "Mounted Wheels," a 32-page illustrated handbook published by the Carborundum Co. The wide range of wheel shapes and sizes, the variety of abrasives and coated discs, sleeves and cartridge rolls available for use on lightweight, high-speed portable grinders are discussed and depicted. Photographs and diagrams are used to provide correct identification and selection to illustrate careful handling and storing and to show proper and efficient applications. This booklet explains how best results may be attained by users of light, high-speed machines for all types of grinding. It tells the abrasives that should be used for grinding cast iron and plastics, high speed and alloy steels, brass and bronze, aluminum and annealed malleable iron.

MR111—The first color motion picture to show the production of aluminum from raw bauxite to finished products, "Pigs and Progress," has just been released by the Reynolds Metals Co. The 16-mm picture is a sound film. The film represents one of the first attempts to carry non-technical persons behind the scenes and give them an insight into the many processes through which bauxite goes before emerging as metallic aluminum. The picture is available without charge for showings before interested groups.

MR112—A new bulletin published by the Ajax Electric Co., Inc., explains the cyclic annealing of castings and forgings.

MR113—Illinois Testing Laboratories, Inc., has issued a leaflet giving information and data on pyrometers for all types of service, electrical resistance thermometers, portable pyrometers, temperature controllers, dew point indicators and direct reading air velocity meter. Specifications are listed for each item and all products are illustrated.

MR114—Frederic B. Stevens, Inc., started distribution of a general catalog, containing more than 600 pages. It is complete with illustrations, showing the variety of foundry equipment and supplies handled by the concern. Also included are bits of foundry information pertinent to modern foundry practice.

CHAPTER ACTIVITIES

(Continued from Page 74)

The vast majority of foundrymen run their silicon in their iron too high, Mr. McElwee said. Silicon has two effects: (1) hardening the ferrite and (2) softening the iron by the reduction of combined carbon. The value of high carbon iron was pointed out by the speaker.

Oregon

W. R. Pindell
Northwest Foundry & Furnace Co.
Chapter Director

THE CHAPTER MET JANUARY 15 at the Heathman Hotel, Portland, to hear J. W. Cable, director of research, Induction Heating Corp., Brooklyn, discuss "Dielectric Core Baking." Prior to the discussion, a movie entitled "A Trip Through the A. P. Green Firebrick Plant," was shown.

After a brief discussion of the theory involved, Mr. Cable traced the history of the development of dielectric core drying. He then showed, by the use of slides, the electronic oven in operation, describing the construction of the oven and the sequence of the baking process. Having several sample cores at hand, Mr. Cable illustrated the capacity and limitations of the dielectric process. Discussion was lively.

Tri-State

R. W. Trimble
Bethlehem Supply Co.
Chapter Chairman

SPEAKER OF THE EVENING at the January 16 Tri-State chapter meeting was Dr. Allen D. Brandt, industrial hygiene engineer, Bethlehem Steel Co., Bethlehem, Pa. Attendance at the dinner and meeting, which was held at the Mayo Hotel, Tulsa, was over forty. The subject of Dr. Brandt's talk was "Dust Control in the Foundry." The speaker pointed out that dust and fumes which may exist in some foundries have an effect on disease, labor relations and attitude toward foundry work.

Canton District

Nils E. Moore
Wadsworth Testing Laboratory
Chapter Reporter

A PROBLEM, DESIGNED AND SUBMITTED to members several days prior to the January 15 meeting of the chapter, formed the basis of discussion for the Canton group at its meeting in Massillon January 15. The ninety-six members present discussed "How to make 100 castings for a 4-in. cam-actuated throttle valve for temperature control spray, 1500 psi water pressure—material to be steel; gray iron, malleable or bronze." Blueprints and information for the meeting were distributed by George Biggert, United Engineering & Foundry Co., Canton, and M. G. Winters, Winters Foundry & Machine Co., Canton.

Dr. Allen D. Brandt, Bethlehem Steel Co., Bethlehem, Pa., addressed the January meeting of the Tri-State chapter. Seated (starting left) Dr. Brandt; Chapter Chairman R. W. Trimble, Bethlehem Supply Co., Tulsa; Chapter Director C. H. Bently, The Webb Corp., Webb City, Mo.; and Chapter Vice-Chairman Dale Hall, Oklahoma Steel Castings Co., Tulsa. Standing (left to right) Chapter Secretary C. B. Fisher, Enardo Foundry & Mfg. Co., Tulsa; Chapter Director Fred E. Fogg, Acme Foundry & Machine Co., Blackwell, Okla.; Chapter Director M. C. Helander, Enardo Foundry & Mfg. Co.; Chapter Director B. P. Glover, M. A. Bell Co., Tulsa; and Chapter Treasurer F. G. Lister, Chicago Pneumatic Tool Co., Tulsa.

(Photo courtesy J. F. Eaton, Bethlehem Supply Co., Tulsa)

Central Michigan

C. C. Sigerfoos
Michigan State College
Chapter Vice-Chairman

CLEANING ROOM PROBLEMS featured the January 14 meeting of the chapter. The program started with a sound film of the Ford River Rouge foundry and the Pangborn monorail type cleaning machine. Following the movie, two men from the Albion Malleable Iron Co., Albion, took charge of the meeting. Chapter Secretary Fitz Coghlin, Jr., chairman of the technical meeting, introduced Jack Durr who led the round table discussion. Aiding in answering questions were D. R. Bair, W. I. Gladfelder and L. W. Unger, all of Pangborn Corp., Hagerstown, Md.

During the discussion period it was pointed out that in a cleaning machine using a metal abrasive applied by centrifugal force, one of the major problems of the unit is the removal of sand that becomes mixed with the abrasive. For example, a cylinder block line usually adds four pounds of sand (per casting) to the abrasive and in a bath tub foundry about forty pounds of sand must be removed from each casting. If this sand is not efficiently removed from the metal abrasive by the machine, effective cleaning stops and excessive wear on the rotor vanes will result.

In further discussing the shot blasting problem, it was pointed out by the Pangborn representatives that centrifugal blasting machines should be provided with an automatic feed for the new abrasive. The practice of manually adding a large amount of new abrasive to a machine at one time, often results

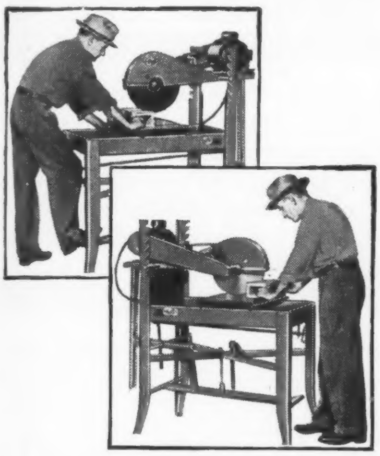
(Continued on Page 80)

NEW Foundry Products

Readers interested in obtaining additional information on items described in New Foundry Products should send requests to Reader Service, American Foundryman, 222 W. Adams St., Chicago 6, Ill. Refer to the items by means of the convenient code numbers.

Blast Nozzle

MR1—Bodine Tool & Machine Co., has a wear-proof nozzle which contains a lining claimed to be hard as a diamond and protected from impact or blow by means of a steel shell. Nozzles are available in all sizes from $\frac{3}{32}$-in. to $\frac{1}{2}$-in. inclusive. Can be furnished with screw connections or any other type.



Fire Brick Saw

MR2—The Clipper Mfg. Co. makes a masonry saw designed for cutting fire brick, tile, brick, and quarry tile. Among the features are dual belt drive for increased power, snap-on-blade cover, streamlined positions for instant one-man change, and fully adjustable conveyor clamps, both elevating and non-elevating types. When working in a confined area, turn on the circulating system and dust is immediately and completely eliminated. Water is circulated from the reservoir, which is an integral part of the frame, by means of a pump mounted on the cutting head.

Vibrating Screen

MR3—Link-Belt Co. has developed a vibrating screen to meet a constantly-growing demand for an effective sizing of a large variety of materials. The screen is an inclined floor-mounted or spring-and-cable suspended type with a balanced two-bearing vibrator mechanism which imparts a concentric or circular vibrating motion to all points of the screening surfaces. Can be used for both medium and heavy duty sizing as well as for scalping and dewatering or rinsing operations. Made with double and triple decks and in sizes ranging from 3 x 8 ft. to 6 x 14 ft.

Prime Mover

MR4—A materials handling device, with the capacity of 1000 lb of wet or dry materials and the ability to climb a 20 per cent grade with full load is being produced by Bell Aircraft Corp. The machine has three wheels, is power operated and can be equipped with a bucket or a sturdy steel and wood platform deck. It has a 3 horsepower, air-cooled motor and operates 8 hours on three gallons of fuel. Transmission, clutch and gears are completely enclosed. The bucket has a capacity of 10 cubic feet. The prime mover is 35-in. high, 63-in. long and $31\frac{1}{2}$-in. wide.

Wire Cutter

MR5—A cutter, called the Manco Junior, has been designed to fill the need for a cutting tool between the wire cutter and bolt cutter. The manufacturer claims, fifty lb pressure at the handles affords two tons cutting power at the jaws. The tool is only 12-in. long but can be used to cut mild steel bolts up to $\frac{1}{4}$-in., rods, screws, rivets, nails, core wires and other materials.

Safety Shoe

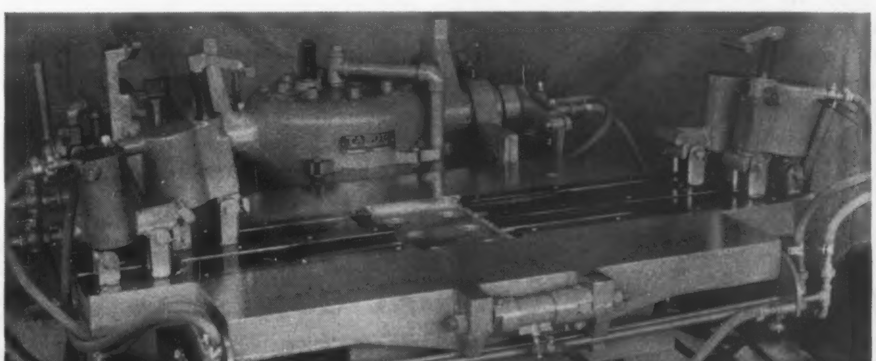
MR6—The "executive" type safety shoe can be worn on the job or for dress. It has a heavy outersole, half-rubber heel with leather base, steel shank, and patented steel toe box. The shoe is the product of the Lehigh Safety Shoe Co.

Temperature Controller

MR7—A temperature controller designed for use with electrical and gas heating units has been announced by the K. H. Huppert Co. Available with or without pyrometers, this step-less input controller is suitable for electric and gas furnaces, ovens and other similar applications. It weights $5\frac{1}{4}$ lb and comes equipped with a pyrometer calibrated to 2000 F or other temperature ranges.

Air-Operated Clamp

MR8—Tabor Mfg. Co. has developed a double air-operated clamp for use with rollover machines. This operation which formerly required from 5-10 minutes now takes only about that many seconds. When the clamp is used, the pattern board or box is placed on the rollover table in an appropriate central position; the two lower clamps are slid in to clamping position against the ends of the pattern board or core box and the air turned on. The pattern board or core box is firmly locked in position throughout the run, at the end of which its removal is just as easy and rapid as removing, or securing, a flask. Bottom boards are clamped in the same manner. After the first mold has been rammed and struck off and the bottom board put in place, the two taller clamps are slid into clamping position and the clamps adjusted for height. Core plates are handled similarly.

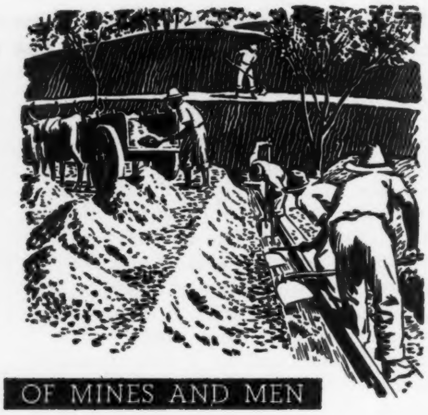


ONE OF A SERIES ABOUT ALLOYING METALS . . . WHERE THEY COME FROM AND HOW THEY ARE USED

THE STORY OF ZIRCONIUM

MULTI-LINGUAL

1 Ancient Persians used the word "zargun" to mean gold-colored. The term "zargun" has become "zircon" through the Arabic, Portuguese, and French languages. The mineral zircon has yielded the element "zirconium," first isolated in 1824 by the Swedish chemist Berzelius.



OF MINES AND MEN

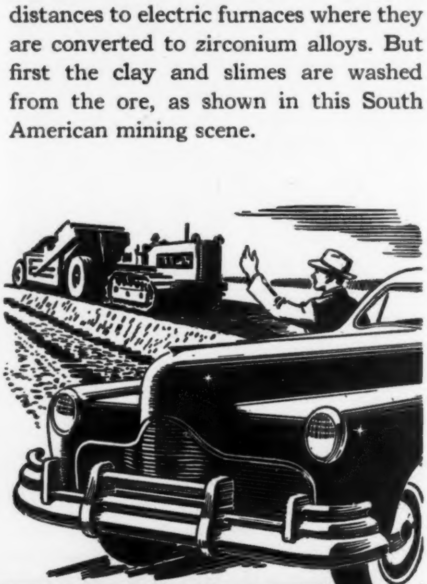
2 From deposits in the United States, Australia, South America, and other parts of the world, ores travel great distances to electric furnaces where they are converted to zirconium alloys. But first the clay and slimes are washed from the ore, as shown in this South American mining scene.

EXPERIMENT TO EXPERIENCE

3 Prior to the entrance of the United States into the first World War, Electromet was conducting experimental work on zirconium alloys, and was able to produce these alloys in large quantities. Again, throughout World War II, Electromet met far greater requirements for zirconium.

VERSATILE PERFORMER

4 Zirconium alloys are of great service to the steelmaker. Not only is zirconium a powerful deoxidizer, but it is extremely reactive with nitrogen and sulphur as well. Generally used as a ladle addition, zirconium alloys are sometimes added to the bath when steel is made in electric furnaces.



GREAT FOR TOUGHNESS

5 For high-strength steel parts which must be cold-formed, zirconium is important. Rock drills, rails, axles, and crankshafts—all requiring maximum toughness—benefit by additions of zirconium alloys because of their thorough deoxidation and cleansing effect. Depth hardenability is increased.

Questions on Alloys?

Electromet produces alloys of 12 to 15 per cent and of 35 to 40 per cent zirconium, as well as other special zirconium-containing alloys. To aid ferro-alloy users in selecting the proper alloy for their needs, Electromet's staff of experienced metallurgists stands ready to assist you. An explanation of this unique service, and descriptions of Electromet products are included in the booklet, "Electromet Ferro-Alloys and Metals," available by writing our Technical Service Department.

ELECTRO METALLURGICAL COMPANY

Unit of Union Carbide and Carbon Corporation

30 East 42nd Street UCC New York 17, N. Y.

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Electromet

TRADE-MARK

Ferro-Alloys & Metals

CHAPTER ACTIVITIES

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in a poor grain distribution and low cleaning efficiency. In presenting information on grain shape, it was mentioned that in the case of thin castings, grit is usually more desirable to use than round shot because the grit has less tendency to warp the casting. If a peening effect is desired and part of the cleaning action depends upon the rebound of the abrasive, then round shot is desirable. The question came up regarding the wear on the rotor vanes and it was agreed that vane life depends, for the most part, upon the per cent of sand in the abrasive that is returned to the rotor. A high sand return means a low vane life. In concluding the discussion period, it was pointed out that many alloys have been tested for wear in the rotor vane application by the machine builders and as a result the vanes supplied by the manufacturer, in general, will give the greatest return for the money invested.

Quad City

C. R. Marthens
Marthens Co.
Secretary-Treasurer

Over one hundred and twenty-five members and guests attended the chapter meeting held January 19 at the Fort Armstrong Hotel, Rock Island, Ill. The speaker was Harry H. Kessler, Sorbo-Mat Process Engineers, St. Louis, and his subject was "Gates and Risers."

Chapter Vice-Chairman M. H. Liedtke, International Harvester Co., Rock Island, presided at the meeting. The subject matter was of extreme interest to the gray iron foundrymen in the area.

Connecticut Non-Ferrous

J. V. McCarthy
Association Reporter

An enlightening talk on health hazards in the foundry, what some concerns have done to eliminate or minimize them, and how the state bureau of industrial hygiene works with industry to make the foundry a better place to work were some of the important points covered by L. W. Woodhouse, principal industrial hygiene engineer, Connecticut State Department of Health, Hartford, at the January 21 meeting

of the Connecticut Non-Ferrous Foundrymen's Association.

Mr. Woodhouse pointed out that: (1) common dirt is not particularly hazardous to health but free silica is a hazard; (2) zinc oxide fume is not toxic and "zinc shakes" are not apt to cause more than temporary sickness, but lead oxide is toxic and often is present along with zinc oxide fume; (3) old time foundrymen are the hardest to "educate"; and (4) the Bureau works to best advantage with those concerns able and willing to go in for modernization, especially of ventilating and dust removal equipment.

Slides illustrating the proper use of exhaust hoods in various industrial operations were shown.

Mexico City

N. S. Covacevich
N. S. Covacevich Foundry Supplies
Chapter Secretary

OFFICERS were elected at the January 16 meeting of the Mexico City Chapter. The following men will head the chapter during 1948: *President,* Ing. F. Gonzalez Vargas, consulting chemist and metallurgist; *Vice-President,* Sr. Pedro Quintanilla,, Industrial de San Bartolo; *Secretary,* N. S. Covacevich, N. S. Covacevich Foundry Supplies; *Treasurer,* David E. Stine, general foundry superintendent, La Consolidada; *1st Director,* Ing. Ernesto Macias Sauza, general manager, Fundiciones y Talleres America; *2nd Director,* Ing. J. Arquicida, Fundicion de Hierro y Acero; *3rd Director,* Alfredo Cruz Garcia, Fundicione Sabino.

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D. J. Reese, International Nickel Co., Inc., New York, addressing the recently organized Eastern New York chapter.

PERSONALITIES

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James M. White, vice-president in charge of manufacturing, Allis-Chalmers Mfg. Co., Milwaukee, announced his resignation effective January 17. He will remain in an advisory capacity to President Walter Geist for the next six months.

W. A. Roberts and **W. C. Johnson,** executive vice-presidents, Allis-Chalmers Mfg. Co., Milwaukee, have been elected to the firm's board of directors. Mr. Roberts is executive vice-president in charge of the tractor division and Mr. Johnson, general machinery division.

The new directors succeed the late Dr. C. E. Albright and Harold S. Falk, president, Falk Corp., who recently resigned.

Appointment of **Theodore I. Leston** as vice-president in charge of production, Eutectic Welding Alloys Corp., New York, was announced recently.

A graduate of Arnstadt Polytechnic Institute in chemical engineering, Mr. Leston completed his metallurgical training at Faculte des Sciences, Paris, and New York University. At the Faculte, he worked under Madame Curie. He is an A.F.A. member.

Dr. G. V. Slottman, formerly manager, technical sales division, Air Reduction Sales Co., New York, has been appointed technical assistant to the vice-president. **Scott D. Baumer,** formerly assistant manager, technical sales division, was appointed manager of that division and **Edward H. Roper** was appointed assistant manager.

Dr. Slottman has been with Air Reduction for 12 years, while Messrs. Baumer and Roper have been with the organization since 1941 and 1936, respectively.

Ian B. MacLellan has been appointed general manager, Newcomb-Detroit Co., Detroit. **Richard W. Wenzell** was made manager of the company's Grand Rapids division which was formerly known as the Newcomb Engineering Co.

Harry Pinkus has been made western division sales manager, James Flett Organization, Inc., Chicago. In simultaneous advancements **James Corbin** was appointed sales manager, eastern division, New York, and **Chelson E. Sayer,** manager, Cleveland office.

Announcement of the appointment of **Mark A. Clements** as general service manager, Caterpillar Tractor Co., Peoria, Ill., to succeed **D. O. Nash,** who has resigned the post, has been made. Mr. Clements, who has served since October, 1946 as western manager with headquarters at the San Leandro, Calif., plant, has been with the company since 1936.

J. Dean Uhll, who has been central division service manager, succeeds Clements at

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PERSONALITIES

(Continued from Page 82)

San Leandro. He joined the company in 1936. Succeeding him as central division service manager is **Ellsworth M. Iverson,** who joined the company in 1937 and held various positions. His post as service engineer has been filled by **T. M. Fahnestock,** a mechanical engineer associated with service engineering since 1937.

John Doerfner, Jr., has been appointed plant manager of a new gray iron foundry now being built by General Motors Corp. at Defiance, Ohio. **Carl H. Beverly** will be resident controller.

Edward B. Nitchie has been appointed manager of operations and engineering, Basic Refractories, Inc., Cleveland. Mr. Nitchie was formerly associated with Cutter Laboratories, Berkeley, Calif., as works manager.

Appointment of **Merle J. Graham** as manager, West Leechburg, Pa., plant of Allegheny Ludlum Steel Corp. was announced recently. **Frank G. Benford** was also named assistant plant manager.

Mr. Graham joined the company in 1933 after graduating from Lehigh University. He was acting plant manager since 1947.

Mr. Benford was graduated from Pennsylvania State College as a metallurgical engineer and until 1944 worked as metallurgist, General Electric Co., Schenectady, N.Y. He joined Allegheny Ludlum as chief metallurgist, West Leechburg plant, in 1945.

Ralph N. Schaper, formerly assistant general manager of operations, Westlectric Castings, Inc., Los Angeles, is now with The Marion Malleable Iron Works, Marion, Ind. Mr. Schaper took an active part in the A.F.A. Southern California chapter and was its chapter reporter. He is now affiliated with the Central Indiana group.

R. D. Baysinger has been appointed superintendent of the foundry division, Greenlee Bros. & Co., Rockford, Ill. **R. L. Rollins** was promoted to foreman, heavy molding, foundry division.

William Brammer, formerly with Thompson Products, Inc., Cleveland, is now aluminum foundry superintendent, Nylen Products Co., St. Joseph, Mich.

R. J. Bryan, Dr. P. K. Koh, G. I. Bottcher and **C. M. Binney** recently received promotions from Allegheny Ludlum Steel Corp. Mr. Bryan was named plant manager, Buffalo foundry, of which he has been assistant manager since 1937. He has been in the industry for 33 years and has been affiliated with American Steel Foundries, Fort Pitt Steel Casting Co. and other steel concerns.

Dr. Koh served for two years in metal-

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PERSONALITIES

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lurgical research with Standard Oil Co. of Indiana, Chicago, before joining Allegheny Ludlum. He has been made associate director of research in charge of tool and die steel and allied products.

Mr. Bottcher, who was named assistant chief engineer, became a member of the engineering staff in 1940. He was made a construction engineer in 1946.

Mr. Binney has been appointed assistant district manager, New York sales district.

Russell E. Birdsall, formerly associated with E. W. Bliss Co., New York, as works controller, is now with American Machine & Foundry Co., New York.

George Strahan, for 17 years associated with the International Nickel Co., Inc., New York, in their sales department, has joined Westlectric Castings, Inc., Los Angeles, as sales manager.

A.F.A. Medallist **Fred L. Wolf** and his wife are spending the winter in Tucson, Ariz. Their address is Sierra Vista Lodge, 2512 Grant Road.

A recent visitor to the A.F.A. National Office was **Dr. Mohammed Anwar–Ul Haque,** 57-A, Ferozepur Road, Lahore, West Punjab, Pakistan, who is enroute home via England. He recently received his master's degree in metallurgical engineering from the University of Utah, Salt Lake City.

William Grede, Grede Foundries, Inc., Milwaukee, has been elected to the University of Wisconsin foundation, a nonprofit organization raising 5 million dollars for a campus building project.

Dr. Robert F. Mehl, director, metals research laboratory and head, department of metallurgical engineering, Carnegie Institute of Technology, Pittsburgh, has been appointed to the Committee for the Distribution of Radioisotopes.

J. P. Cantor has been made district manager, Cleveland, Wheelco Instruments Co., Chicago. In another advancement, **Herbert Proske** is now assistant district manager, New York.

Charles F. Walton, formerly associated with the Mechanite Metal Corp., New Rochelle, N.Y., has joined the staff, Case Institute of Technology, Cleveland. He will specialize in foundry subjects.

Hugo E. Johnson, formerly research associate, Carnegie-Illinois Steel Corp., has been appointed to the administrative staff, Battelle Memorial Institute, Columbus,

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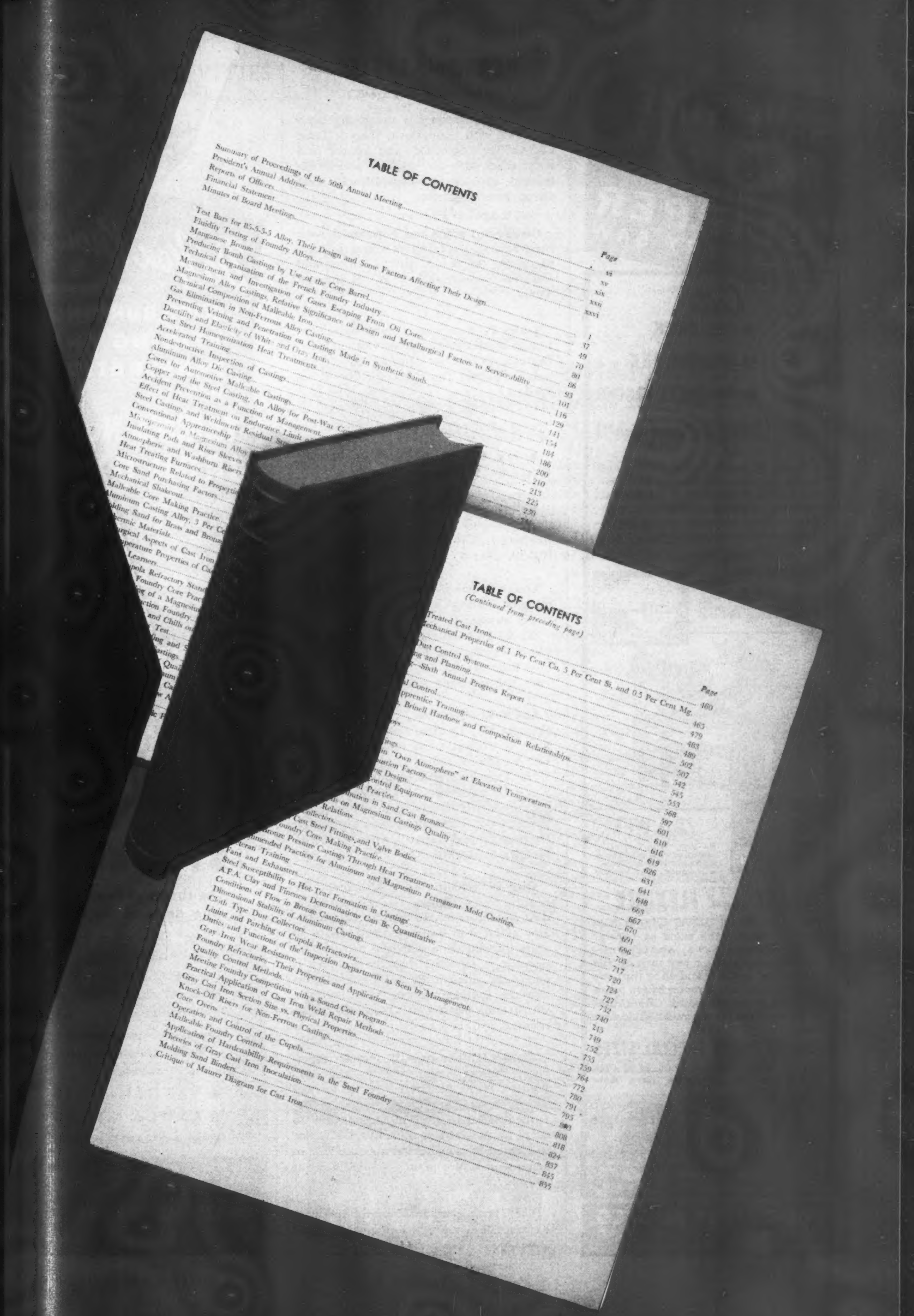
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Ohio. Mr. Johnson has previously been associated with Youngstown Sheet & Tube Co., Carnegie Steel Co., and for the past seven years with the research and development division, Carnegie-Illinois Steel Corp., Pittsburgh, Pa.

George H. Carden and **T. G. Smith** have been named, respectively, manager, Allis-Chalmers Baltimore district office, and resident representative at Beaumont, Texas.

James P. Tate was recently appointed Brazilian sales agent and service engineer, Herman Pneumatic Machine Co., Pittsburgh, Pa. Mr. Tate's office will be in Sao Paulo.

Obituaries

Arthur Bidwell, 58, Superior Bearing Bronze Co., died recently.

William F. Beaudway, president, Chicago Malleable Castings Co., Chicago, and executive vice-president, Allied Steel Castings Co., Harvey, Ill., died January 28.

Emery R. Bales, secretary-treasurer, Wilmington Casting Co., died January 16.

W. Alfred Diehlenn, 72, president, Massillon Refractories Co., Massillon, Ohio, died February 10. He had been identified with the company since 1921.

Louis E. Keen Sr., president, Keen Foundry Co., Griffith, Ind., died recently. Born in Toledo, Ohio, in 1881, Mr. Keen was employed there as superintendent, U. S. Malleable and Maumee Malleable foundries until 1914. He then built and became superintendent, Wanner Malleable Castings Co., Hammond, Ind., until 1927. He resigned and started his own gray iron foundry in Griffith.

Otto W. Schaum, 81, chairman of the board, Fletcher Works, Inc., Philadelphia, died December 8. He had been the operator of an iron foundry for the past 50 years in connection with the textile business. It is reported that the foundry is one of the oldest in Philadelphia. He was also the founder of the Atlas Ball Co. which later merged with the SKF industries.

Charles H. Johnstone, 52, foundry supervisor, Wilson Foundry & Machine Co., Pontiac, Mich., died recently. He learned his trade in Toronto and came to the United States in 1925 and worked for 16 years for the Michigan Alkali Co. Prior to joining Wilson he was an expediter in a naval ordnance plant. He had been at Wilson for three years.

Lee Hayes, assistant foundry foreman, Kewanee Boiler Corp., Kewanee, Ill., died January 17. He was an A.F.A. member.

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Ohio State

Eldon Boner
Secretary

A JOINT MEETING between the Ohio State Student chapter of A.F.A. and the American Ceramic Society was held on February 3. "Foundry Refractories" was the subject presented by H. M. Kraner, research ceramic engineer, Bethlehem Steel Co., Bethlehem, Pa.

Mr. Kraner said that good castings are largely dependent upon sands and refractories. Effects of alumina contained in clay, on the sand, and the effect the sand has on the casting were discussed by the speaker. Other subjects discussed were bonds for sands, and the form sand grains take under pressure.

Twin City

O. J. Myers
Werner G. Smith Co.
Chapter Reporter

HISTORICAL AND factual information on chemically bonded sand was given by T. E. Barlow, sales manager, Eastern Clay Products, Inc., Jackson Ohio, on February 5 when he talked before the Twin City chapter. One hundred members and guests attended the dinner at the Covered Wagon and the technical session.

Mr. Barlow took up the history of molding practice in the first part of his talk. He explained that the first castings were poured into sandstone molds whose cavities had been chiseled to shape by hand. This practice was followed by the use of naturally bonded sands, and then in 1924 synthetic sands started to become prominent. The most recent development in molding is the use of chemically treated sand.

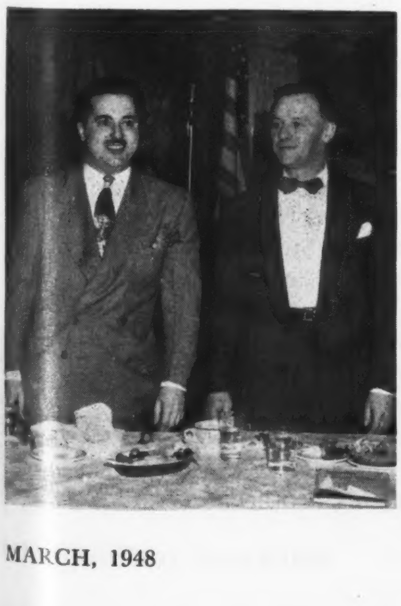
The original idea for chemically treated sand was to eliminate not only clay and water from the molding sand, but actually the sand itself. B. M. Weston visualized pouring castings into a pure refractory plastic; but, since it was uneconomical to do this, he used sand grains as a "filler."

The original chemically bonded sand was the so-called "waterless sand" composed of sand grains coated with a carbonaceous chemical. These sands knit together by

(Concluded on Page 95)

T. E. Barlow (left), Eastern Clay Products, Inc., Jackson, Ohio, at the speaker's table with Chapter Chairman S. P. Pufahl, Pufahl Foundry, Inc., Minneapolis.

(Photo courtesy Pufahl Foundry, Inc.)



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"wetting" with organic solvents—a sort of gluing action. No clay or water was used with this original material and, therefore, it never dried out and was extremely stable.

Production tests of this original clay-free sand showed that it possessed the following disadvantages: (1) It had too much flowability and therefore it could only be molded with a squeezer and could not be rammed or jolted since these latter two processes would cause the material to "bounce" and not pack; and (2) There was so much plastic and solvent in the mixture that the sand would burst into flame at shakeout.

During October, 1946, a compromise was made between the original sand and regular synthetic molding sands. This compromise did not "eliminate the cleaning room" as did the original material; however, it did permit greater latitude in foundry production.

This compromise consisted of adding both clay (western bentonite) and water to the chemically bonded matrix. The chemically bonded sands now contain about half as much clay and water as do regular synthetic sands so they may be classified as "semi-chemically bonded."

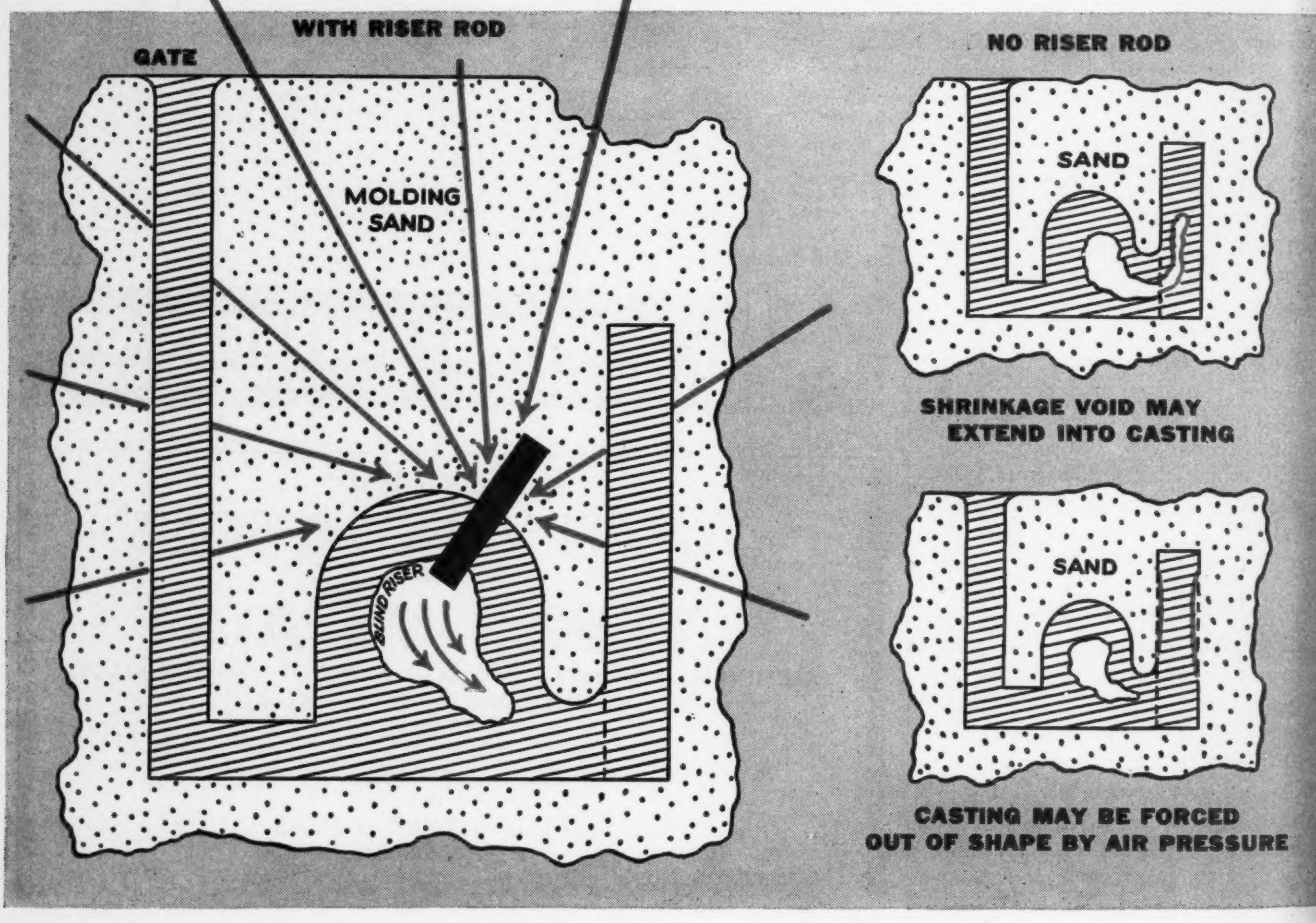
Dispose of Old Sand

To start a chemically coated sand system today one must throw out all of his present molding sand heap. The next step is to purchase a sufficient supply of the coated sand. To this sand, approximately 2.5 per cent western bentonite should be added together with 2.25 per cent water and one quart of liquid chemical per 1000 lb of sand. Each time this sand is returned to the muller, dry, as well as liquid chemical compounds, clay and water must be added to the mixture to maintain the same physical properties of the material as was present in the first batch of sand. Wood flour, and cereal binders may also be used.

In summary, Mr. Barlow claimed the following advantages for this product: (1) Better casting finish; (2) A finer sand can be used without sacrificing permeability ; (3) Excellent flowability and toughness; (4) Faster mulling possible; and (5) More rapid shakeout.

Air pressure feeds your casting with sound metal!

(WHEN YOU USE "NATIONAL" GRAPHITE RISER RODS)



● By inserting a "National" graphite riser rod into the mold—as shown above—you keep the blind riser open to the atmosphere during solidification of the metal. The red arrows show how air pressure pushes powerfully through this hole. It forces molten metal into the casting with considerable force.

The result: Air pressure works *for* you—not *against* you. Air pressure does not warp the casting out of shape, as it might if there were no riser rod to relieve the internal shrinkage. Air pressure packs metal where a vacuum tries to exist, and the shrinkage void is left in the riser...not in the casting. The result is a sound, true-to-shape casting.

You can buy "National" graphite riser rods in standard sizes...from the smallest to the largest. They reach you in a handy package, all ready to place in the mold. "National" graphite riser rods save time because they are so easy to use. They do a better job than other rods because they keep riser metal fluid longer—force-feed more metal into the casting.

The term "National" is a registered trade-mark of

NATIONAL CARBON COMPANY, INC.

Unit of Union Carbide and Carbon Corporation

UCC

30 East 42nd Street, New York 17, N. Y.

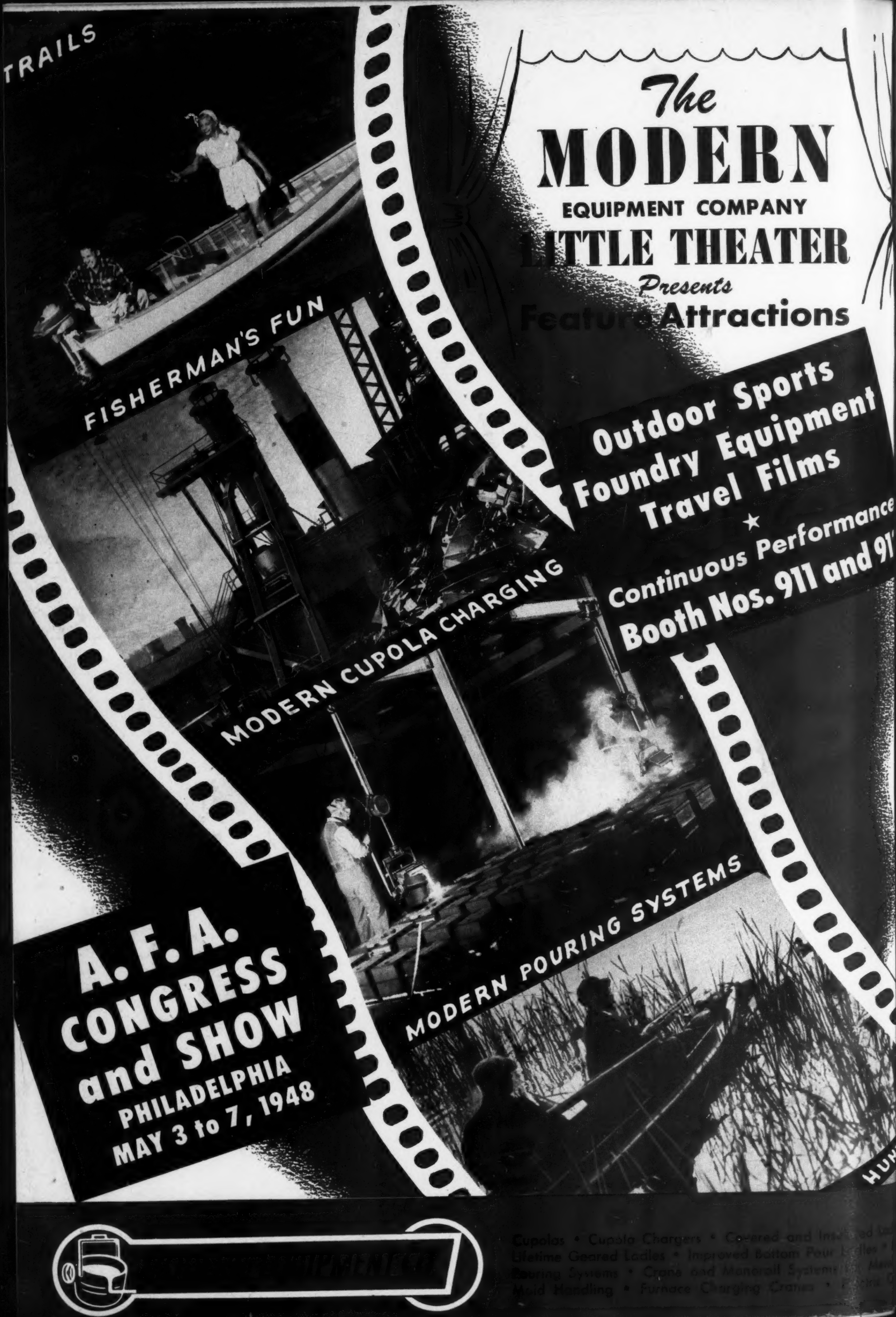
Division Sales Offices: Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco

FOR MORE INFORMATION ON "NATIONAL" GRAPHITE RISER RODS, WRITE TO NATIONAL CARBON COMPANY, INC., DEPT. AF

PRE-CONVENTION ISSUE APRIL 1948

AMERICAN FOUNDRYMAN

THE FOUNDRYMEN'S *Own* MAGAZINE



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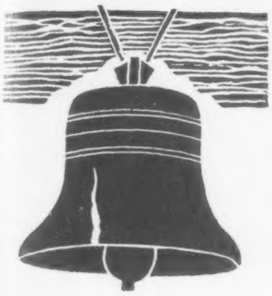


An Invitation To The 52nd Foundry Congress

The American Foundrymen's Association puts on one of its greatest shows in Philadelphia—where the Association was formed in 1896—starting Monday, May 3, and continuing through Friday, May 7. The 52nd Annual A.F.A. Convention and Exhibit, held in co-operation with the foundry equipment manufacturers and foundry suppliers, will show the membership and visitors the latest developments in foundry equipment and foundry materials.

Technical papers prepared by some of the leading operating, technical, and educational men in the foundry industry will cover every phase of foundry practice. Presented at more than 60 meetings during the Convention, the subjects covered are of interest to everyone in the foundry industry.

Management, which can benefit greatly by taking full advantage of advances in foundry technology, should plan to attend the 52nd A.F.A. Convention. In addition to technical developments to be disclosed, management should be interested in the papers and sessions relating to good foundry housekeeping—fundamental and essential to good foundry operation—and to recruiting and training of foundry personnel.

The recruiting and training panel will answer questions foundrymen are asking in connection with the recently publicized A.F.A. five-point plan for bringing new blood into the foundry industry.

Increased attention to technical progress warrants attendance by as many plant operating and technical men as possible.

Operating men will especially want to take advantage of the Sand Shop and the Gray Iron Shop meetings which have been scheduled for evenings so as to be most convenient for Philadelphia-area foundrymen. These off-the-record meetings give practical foundrymen and metallurgists an opportunity to air their views freely, to hear the latest in practical foundry know-how, and to pick up many useful ideas.

We extend to everyone in the foundry industry an invitation to attend the 52nd Annual Convention of the American Foundrymen's Association in Philadelphia. Much can be gained from the exchange of ideas and from the application of the latest in equipment to your foundry problems.

We look forward to seeing you there.

Max Kuniansky

Max Kuniansky, *President*
American Foundrymen's Association

A.F.A. 52nd Annual Convention and Exhibit, Philadelphia—May 3-7, 1948

52nd FOUNDRY CONGRESS

Philadelphia

CONVENTION HALL MAY 3-7, 1948

PHILADELPHIA IS HOST TO THE FOUNDRY WORLD the first week of May, as A.F.A. convenes in Municipal Auditorium there for its 52nd Annual Meeting, the 1948 Foundry Congress and Show, opening Monday, May 3rd, to run through Friday.

Keynote of the five-day Convention and the mammoth Exhibit is *castings today*. New products and processes for the production of more and better castings, more economically, will be in the spotlight throughout "foundry week" in Philadelphia.

In one of the largest shows in its history, the Association brings before an international castings industry audience the latest developments of some 260 firms offering equipment, supplies and services to the foundry field. Among the exhibitors of 1948, along with those organizations long- and well-known to the industry as participants in A.F.A. shows, are many companies that have never been represented, or that have not taken part in recent years.

Growing recognition of the importance of the foundry market and of the value of representation in A.F.A. exhibits is evidenced by the number of progressive firms taking part this year, and by the fact that more new equipment will be on display than at any meeting since 1930.

A.F.A. service to the foundry industry is shown in the Convention technical program, which offers delegates up-to-the-minute data on the most successful methods used in the high-level, low-cost output of quality castings under today's conditions of short supply and substitutions in foundry materials.

Specific and general interest meetings, round tables, panel discussions, instructional lecture courses, symposia, quiz sessions—all centering on the latest developments in metals casting science—have been scheduled by Divisions and General Interest committees. Formal papers have been reviewed by program-papers groups, and most have been distributed to the membership as preprints or published in AMERICAN FOUNDRYMAN.

Early and wide distribution of the technical papers has given leading technologists in various sections of the industry time to study them, and to prepare written discussions, which will add to the value of their formal presentation in Philadelphia.

Thousands of executives and technologists, representing foundries and allied industry firms in every corner of North America, and a sizeable group from industrial centers abroad, will come together on common ground at the A.F.A. Congress. Large numbers will converge on Philadelphia from throughout Pennsylvania, long a leader among "foundry states," as well as from other heavily-industrialized areas within a 500-mile radius of the city.

All will be drawn by the wide-spread interest of progressive foundrymen everywhere in tools and techniques to meet the demands of the times, and by their own recognition of the benefits that are obtained by the constantly-expanding membership of the Association through its technical-educational programs, research projects and other activities.

Advance registration indicates that the recent level of attendance, that rose to record height at both the last Convention and Exhibit, the "Golden Jubilee" of 1946 in Cleveland, and last year's non-exhibit gathering in Detroit, will be maintained.

Returning to Philadelphia, the city of its birth, for its sixth assemblage there, A.F.A. is prepared to turn the full energies of its more than 10,000 members, as expressed through their national committees, to promotion of "the arts and sciences applicable to metal castings manufacture."

Quiz Sessions Scheduled

Four Convention sessions will offer delegates direct advice on their individual problems through the quiz type program. Leading off, the Educational Division will present a six-man panel at its technical session of Monday morning, May 3rd, which will handle queries on the recruiting and training of foundry personnel, many of which have been submitted in written form.

Members of the panel are Professor G. J. Barker of the University of Wisconsin, Madison; I. Ivan, apprentice supervisor at Whiting Corp., Harvey, Ill.; Glenn Kies of Industrial Training Service, Detroit; H. L. Rosse of Eddystone (Pa.) Borough Schools; F. B. Skeates, superintendent of foundries, Link-Belt Co., Chicago, and Professor R. S. Tour of the University of Cincinnati. Professor W. H. Ruten, Polytechnic Institute of Brooklyn, will preside, and L. G. Probst, National Engineering Co., will serve as co-chairman.

The same session will feature a paper by G. K. Dreher, executive director of the Foundry Educational Foundation, Cleveland, *Engineering Education for the Foundry Industry.*

Continuing the pass-the-information theme, the Refractories Committee will devote its Wednesday evening meeting to a question-and-answer program of the type it has sponsored at past Conventions and found highly successful and popular.

A. S. Klopf of Western Foundry Co., Chicago, is chairman for the refractories quiz; Carl F. Joseph, Central Foundry Div., General Motors Corp., Saginaw, Mich., co-chairman.

Foundry Cost Committee members take their turn as consultants to the industry Thursday afternoon. Foundry cost accounting methods, distribution of costs, and application of cost data, are to be covered as speakers analyze and discuss specific problems of broad general interest to the field.

Committee Chairman R. L. Lee, secretary-treasurer of Grede Foundries, Inc., Milwaukee, will preside.

Following the cost meeting, the Job Evaluation and Time Study Committee will present the fourth quiz session of the Annual Convention. Chairman will be R. J. Fisher, supervisor of standards for the Falk Corp., Milwaukee, head of the committee; co-chairman will be M. E. Annich, superintendent of standards for American Brake Shoe Co., Mahwah, N.J.

Educational meetings during convention week will be of particular interest to all delegates, in view of steps recently taken by the industry to further the education of foundry engineers and technologists. In addition to the Monday morning technical session, the division will sponsor a Round Table Dinner the same day and the annual Engineering School Graduates Luncheon, Wednesday, and also will hold its annual business meeting.

"Management's Responsibility in the Development of Personnel" will be the topic at the dinner, and the featured speaker will be M. J. Gregory of Peoria, Ill., retired foundry superintendent of Caterpillar Tractor Co. Dr. R. M. Brick, director of the department of metallurgy, University of Pennsylvania, will address the graduates luncheon on "Engineering Education."

Chapter educational committee chairmen and other members of the division will discuss local and national projects at the business session. One of the reports expected to be a highlight of this review of A.F.A.-sponsored activities in improving the training of men for foundry positions, is that of the Textbook Committee.

Organized to plan and direct the preparation of new foundry texts for all educational levels, to replace those out of date and not sufficiently broad in scope, the committee has completed arrangements for the writing of a college and a high school text.

Three lecture courses will provide foundrymen with practical working data for today's operations: the annual Gray Iron and Sand Shop courses, and the special series on quality control test procedures sponsored by the Annual Lecture Committee.

Annual Lecture Course Resumed

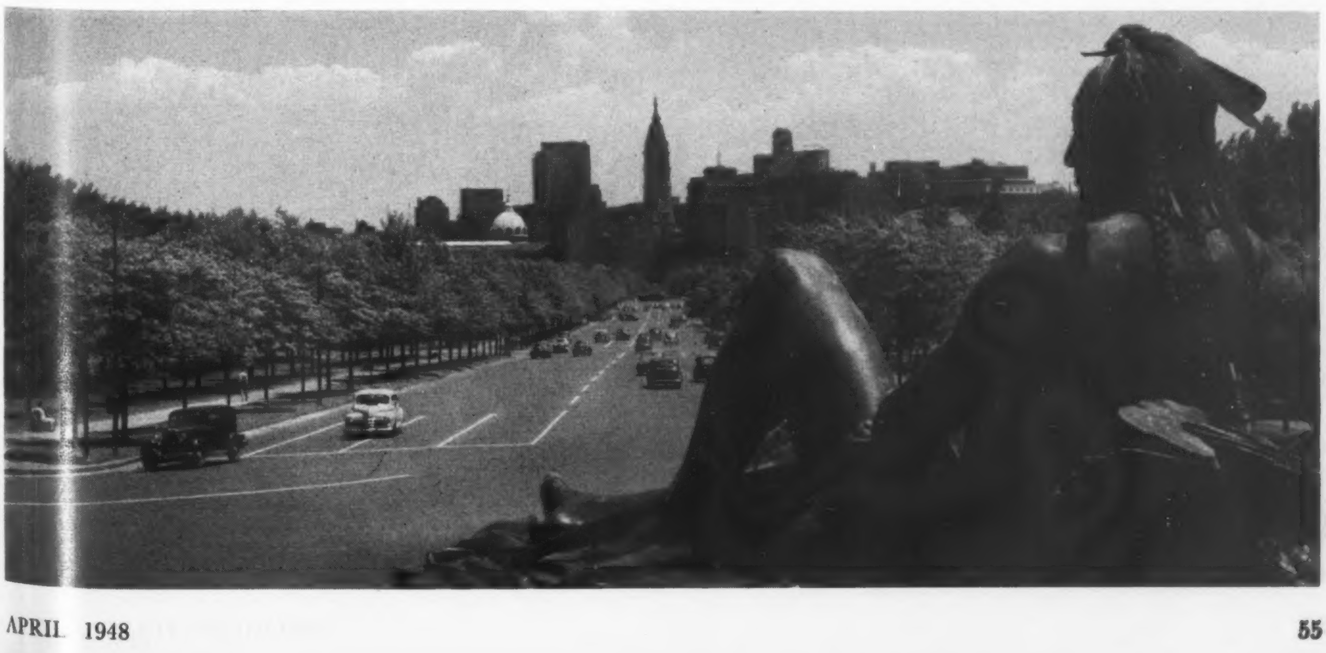
Resumption of the Annual Lecture series brings to this year's Congress five outstanding technical papers relating to a vital phase of successful castings production. Quality testing for aluminum and magnesium; brass, bronze and nickel alloys; malleable iron; gray iron; and steel; will be covered at afternoon sessions (4:00 p.m.) Monday through Thursday, in that order, the brass-bronze and malleable sessions being held simultaneously Tuesday.

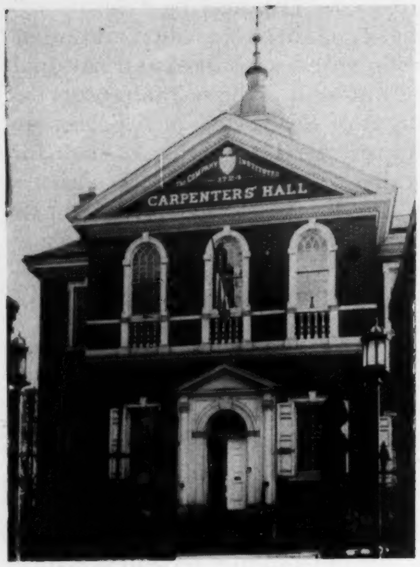
Lecturers are, respectively, E. V. Blackmun, chief works metallurgist, Aluminum Co. of America, Cleveland; William Romanoff, vice-president of H. Kramer & Co., Chicago; M. O. Booth, manager of the Saginaw (Mich.) Malleable plant of General Motors Corp.; F. J. Walls, manager of the Detroit section of International Nickel Co., and J. W. Juppenlatz, chief metallurgist of Lebanon (Pa.) Steel Foundry.

As in recent years, the popular, informal shop courses will be presented at 8:00 in the evening, an hour chosen in order to permit local plant men to attend the lively, off-the-record sessions, which have always been marked by extensive audience-participation. No records are kept, and those in attendance may speak freely in discussion or in questioning lecturers.

Four meetings, Monday through Thursday, are in-

Philadelphia's skyline seen from the Washington Monument, Fairmount Park.





Historic Carpenter's Hall, scene of the first meeting of the Continental Congress, September 5, 1774, and headquarters of the first bank of the United States, 1791.

cluded in each course. That sponsored by the Sand Division will take up practices and problems in nonferrous casting on Monday; malleable iron, Tuesday; gray iron, Friday; steel, Thursday.

Gray Iron course sessions, sponsored by that division, will be devoted to *Front Slagging of the Cupola,* Monday; *Effect of Blast Variation on Cupola Control,* Tuesday; *Cupola Coke,* Wednesday; *Factors Affecting the Fluidity of Cupola Iron,* Thursday.

General Interest committees will feature discussions of modern foundry technology in which there is particularly wide-spread interest at the present time.

Innovations in foundry mechanization, with particular reference to its applications in moderate-sized plants, will be the subject of the Tuesday evening meeting of the Plant and Plant Equipment Committee. L. B. Knight of L. B. Knight & Associates, Chicago, will present *Modernization of the Small Foundry.*

Committee Chairman James Thomson, Continental Foundry & Machine Co., East Chicago, Ind., will preside, and will have as co-chairman E. W. Beach, Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich.

Comprehensive reports of the investigations of the Heat Transfer Committee are scheduled for Tuesday afternoon. The group drew overflow crowds to its meetings in Detroit last year.

Chairman H. A. Schwartz, National Malleable & Steel Castings Co., Cleveland, will present a brief introduction to the report, comprising four papers.

Part 1, *Thermal Conductivity of a Sand Mixture,* is by C. F. Lucks, O. L. Linebrink and K. L. Johnson, Battelle Memorial Institute, Columbus, Ohio; parts 2, 3 and 4, studies of solidification of aluminum castings, white iron castings and steel spheres, were prepared by Dr. Victor Paschkis, Columbia University.

E. C. Troy of National Engineering Co., Philadelphia, Chairman of the host chapter, will preside, and Professor H. F. Taylor of Massachusetts Institute of Technology, Cambridge, will be co-chairman.

Division technical programs and special activities are listed in full in this issue. As has been the practice for the past several years, they have been scheduled in such a manner as to permit delegates to attend the most meetings in their particular fields of interest in the minimum number of days.

Aluminum and magnesium, brass and bronze, educational, and malleable groups have centered their meetings on Monday and Tuesday; pattern group on Tuesday and Wednesday; sand, Wednesday and Thursday; gray iron and steel, Thursday and Friday. Exceptions are the sand and gray iron courses and the Engineering School Graduates Luncheon. However, sand course meetings, and those of the quality control series, correspond in subject matter with the division interest of the days on which they are scheduled.

Foreign Papers Scheduled

Among the technical papers sponsored by the divisions, are four from abroad: exchange papers of the Institute of British Foundrymen, Institute of Australian Foundrymen, and French Foundry Technical Association, and a paper by H. Morrogh of the British Cast Iron Research Association.

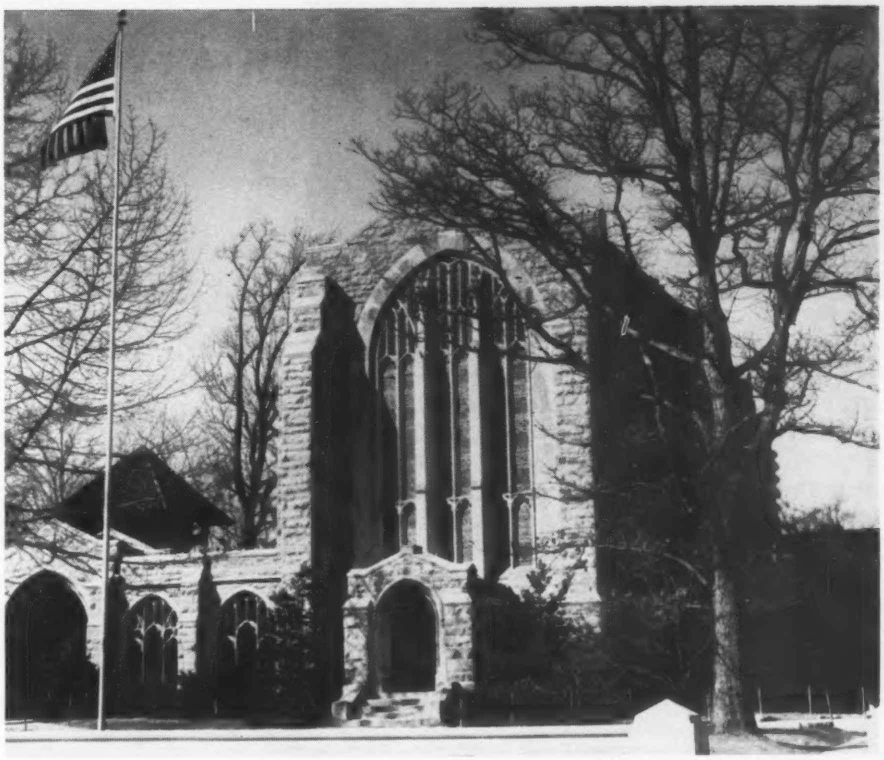
E. Longden, works manager of P. R. Jackson & Co.,

Philadelphia, looking toward Delaware Bridge. New Customs House is at right.

Ltd., Manchester, is author of this year's IBF paper, *Contraction and Distortion in Ferrous Castings,* which is sponsored by the Gray Iron Division and will be presented Friday morning at 10:00. IBF exchange papers have been a feature of every A.F.A. meeting since 1921, and have always been a center of interest as a source of first-hand information on the practices and theories of foundrymen abroad.

Also sponsored by the Gray Iron Group, the paper by Mr. Morrogh, *Production of Nodular Graphite Structure in Gray Cast Iron,* is scheduled for 10 o'clock on Friday morning.

The Technology of Copper-Lead Alloys, exchange paper of the Institute of Australian Foundrymen, is to be read by William Ball, Jr., Magnus Brass Div., National Lead Co., Cincinnati, Tuesday morning, 10:00 a.m., at a Brass and Bronze Division meeting. R.W.K. Honeycombe, formerly with the Council of Scientific and Industrial Research, Melbourne, now at Cambridge University, is the author.



The Washington Memorial Chapel at Valley Forge.

Under sponsorship of the Malleable Division, the French paper, *Influence of Chromium on the Graphitization of White Cast Iron,* by Gabriel Joly, head of cast iron metallurgy at the Foundry Industry Technical Center, Paris, will be presented at 10:00 Monday morning. It will be read by C. O. Burgess, Union Carbide & Carbon Corp., Niagara Falls, N.Y.

Hoyt Foundation Lecture

Another major event of the technical program is the second Charles Edgar Hoyt Annual Lecture, *Control of Grain Size in Magnesium Castings,* by Charles E. Nelson, technical director of the magnesium division, Dow Chemical Co., Midland, Mich. Its presentation will be a feature of the Annual Business Meeting, Wednesday morning.

From the opening sessions Monday morning, to the Annual Banquet, Friday, the delegate to this A.F.A. Meeting will have his choice of a rich selection of rewarding activities.

In addition to their technical sessions, A.F.A. Divisions will meet for round table luncheons and annual business meetings.

Leading off with the first Round Table Luncheon, Monday, the Brass and Bronze Division will discuss, "Recent Developments in the Melting of Brass and Bronze." H. L. Smith, chief metallurgist of Federated Metals Div., American Smelting & Refining Co., Pittsburgh, will be discussion leader.

Aluminum and Magnesium, and Malleable luncheons are scheduled for Tuesday. *Development of a Permanent Mold for Aluminum Tensile Test Bars,* by L. J. Ebert, R. E. Spears and George Sachs of Case Institute of Technology, Cleveland, will be presented at the light metals round table, followed by a general discussion on permanent mold casting of aluminum and magnesium alloys.

R. J. Anderson, works manager of Bell City Malleable Iron Co., Racine, Wis., will lead a round table discussion of malleable foundry mechanization.

Pattern Division round table, Wednesday noon, will offer a general discussion of patternmaking, led by Martin Rintz, foundry superintendent of Continental Foundry & Machine Co., East Chicago, Ind.; that of the Steel Division, Thursday noon, will feature a Naval Research Laboratory color film, showing the flow of metal into a mold: "Gating Systems for Metal Casting."

Traditional highlights of the Congress program are the Chapter Officers and Directors Dinner, Tuesday; the business session; the annual gathering of Dominion foundrymen, also on Wednesday; Alumni Dinner of A.F.A. past officers, directors and medalists, Thursday, and the Annual Banquet, Friday.

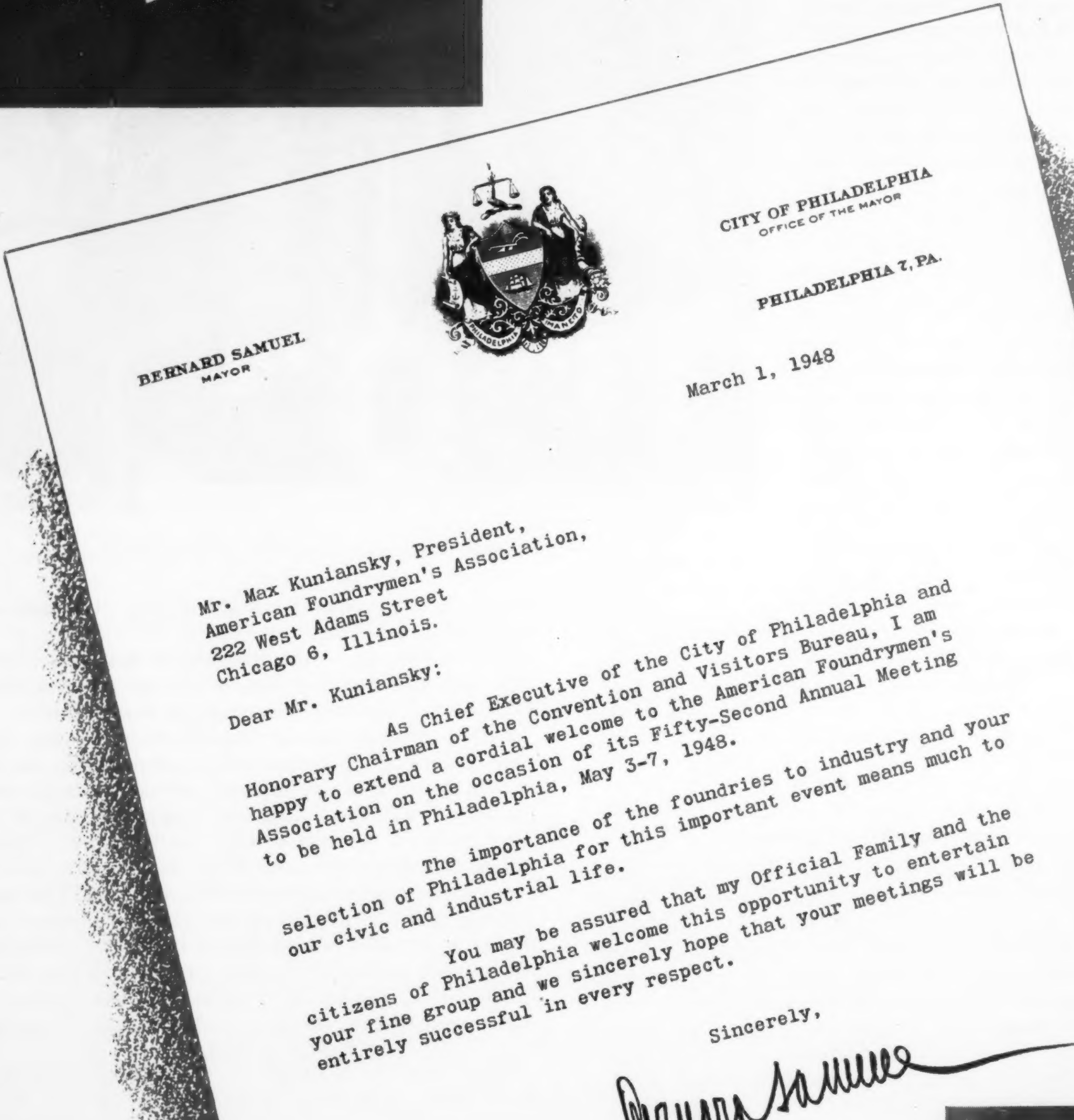
Leaders of 42—perhaps 44 by Convention time—local groups will meet at the Chapter dinner. Four student units and 38 regular chapters are on the membership roster, with two chapter petitions, one for a student organization from Oregon State College, Corvallis and one for a regular chapter at Chattanooga, Tenn., now before A.F.A. Directors.

Seven New Chapters Added

Since the 51st Annual Meeting, last year at Detroit, the British Columbia, Central Michigan, Eastern New York, Missouri School of Mines and Metallurgy, Ohio State University and Massachusetts Institute of Technology chapters have been organized, and that of the University of Minnesota has been reactivated.

A.F.A. Vice-President, William B. Wallis, Pittsburgh (Pa.) Lectromelt Furnace Corp., will preside at the Officers and Directors dinner.

52nd PHILADELPHIA WELCOMES YOU...



BERNARD SAMUEL
MAYOR

CITY OF PHILADELPHIA
OFFICE OF THE MAYOR

PHILADELPHIA 7, PA.

March 1, 1948

Mr. Max Kuniansky, President,
American Foundrymen's Association,
222 West Adams Street
Chicago 6, Illinois.

Dear Mr. Kuniansky:

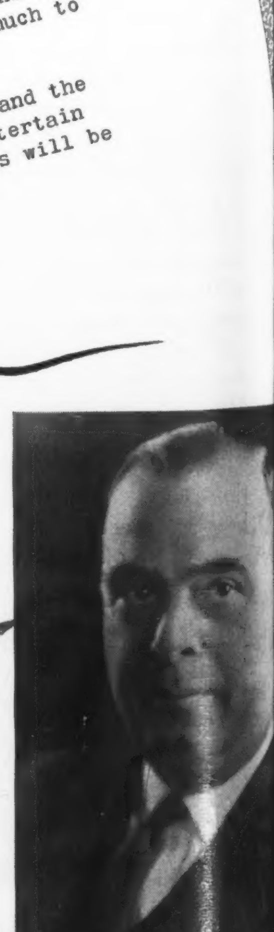
As Chief Executive of the City of Philadelphia and Honorary Chairman of the Convention and Visitors Bureau, I am happy to extend a cordial welcome to the American Foundrymen's Association on the occasion of its Fifty-Second Annual Meeting to be held in Philadelphia, May 3-7, 1948.

The importance of the foundries to industry and your selection of Philadelphia for this important event means much to our civic and industrial life.

You may be assured that my Official Family and the citizens of Philadelphia welcome this opportunity to entertain your fine group and we sincerely hope that your meetings will be entirely successful in every respect.

Sincerely,

Bernard Samuel



Election of National Officers and Directors, the President's Annual Address, presentation of awards to first-prize winners in the 24th Annual Apprentice Contest, and the Charles Edgar Hoyt lecture, will be the feature of the Annual Business Meeting.

President Max Kuniansky will report to the membership on the activities of the Association and its plans for the future. He will also present the prizes to Apprentice Contest winners of the four divisions of the competition, who will be at the Convention as guests of A.F.A.

Canadian delegates will have a dinner meeting this year, rather than the customary luncheon. National Director E. N. Delahunt, Warden King, Ltd., Montreal, will preside. This gathering of Dominion members is the first at which all three chapters of that country have been represented, and will provide an opportunity for members of the British Columbia chapter to compare their experiences of the past year with those of the older Eastern Canada and Newfoundland and Ontario chapters.

Sheldon V. Wood, Minneapolis Electric Steel Castings Co., immediate past President of A.F.A., will serve as chairman of the Alumni Dinner.

Annual Banquet

A.F.A.'s Annual Banquet will be the climax of the Congress and Show of 1948, and the occasion on which the Association will honor, with Gold Medals and Honorary Membership, four who have contributed much to the advancement of the foundry industry.

Egbert H. Ballard will receive the William H. McFadden Gold Medal, to be presented by James L. Wick, Jr.; R. G. McElwee, the John A. Penton Gold Medal, presented by Fred J. Walls, and Peter E. Rentschler, the Peter L. Simpson Gold Medal, which will be presented by Walter L. Seelbach.

President Kuniansky will be recognized for his leadership of the A.F.A. during the past year with Honorary Life Membership.

Dr. Karl Taylor Compton, president of Massachusetts Institute of Technology and a leading scientist and educator, is guest speaker for the dinner. He will discuss, "Team Play of Hand and Brain."

Exhibit Hours

Delegates will have access to the exhibit halls from 9:00 in the morning until 5:30 p.m. Monday and Thursday; from the same morning hour until 4:30 p.m. Friday. Wednesday, the day of the business session, the exhibit halls will not open until 11:00 a.m., and they will close at 5:30 p.m.

Tuesday will be "Philadelphia Day," marked by a series of special activities arranged by the Philadelphia chapter. On that day, local plant men will be admitted to the show without charge, and the exhibit halls will be open from 9:00 a.m. to 9:00 p.m.

Registration of delegates will be conducted only at the main entrance of the Municipal Auditorium, on the 34th Street side (the north side).

Association headquarters will be maintained in the Center Hall, which is located between the Convention and Exhibit halls.

Day-time events of the Congress and Show will be conducted in the Auditorium, those of the evenings, in downtown hotels. Complete details are listed in the official program in this issue.

A week-long program of plant visitations is certain to attract large numbers of delegates, eager to inspect the plants in Pennsylvania and neighboring states. Elsewhere in this issue is the list of firms that will welcome A.F.A. members and guests during "foundry week." Further information will be available at the plant visitation booth in A.F.A. headquarters.

Assembled on the steps of the old Franklin Institute are foundrymen attending the First Annual Convention of the American Foundrymen's Association, held in Philadelphia, May 12-14, 1896. Both the Franklin Institute and the Manufacturers' Club of Philadelphia were used for the initial sessions of this convention.

AFA

CONVENTION PROGRAM, MAY 3-7, 1948

ANNUAL 52nd CONVENTION

MONDAY, MAY 3

8:30 AM—Registration begins
8:30 AM—Exhibits open

10:00 AM (A)—Aluminum and Magnesium

(Sponsored by Aluminum and Magnesium Division)]

Presiding—L. Brown, Magnesium Fabricators Div., Bohn Aluminum & Brass Corp., Adrian, Mich.

Co-Chairman—A. T. Ruppe, Bendix Products Div., Bendix Aviation Corp., South Bend, Ind.

"Effect of Gating Design on Metal Flow Conditions in Casting of Magnesium Alloys"—H. E. Elliott, Dow Chemical Co., Bay City, Mich., and J. G. Mezoff, Saginaw Bay Industries, Inc., Bay City, Mich.

"A Study of Factors Affecting the Pouring Rates of Castings"—H. E. Elliott, Dow Chemical Co., Bay City, Mich. and J. G. Mezoff, Saginaw Bay Industries, Bay City, Mich.

"Step Aging of a Magnesium-Base Casting Alloy"—E. J. Vargo, Wellman Bronze and Aluminum Co., Cleveland, and G. Sachs, Case Institute of Technology, Cleveland.

10:00 AM (B)—Educational

(Sponsored by Educational Division)

Presiding—W. H. Ruten, Polytechnic Institute of Brooklyn, Brooklyn.

Co-Chairman—L. G. Probst, National Engineering Co., Chicago.

"Engineering Education for the Foundry Industry"—G. K. Dreher, Foundry Educational Foundation, Cleveland.

Recruiting and Training Panel—G. J. Barker, University of Wisconsin, Madison, Wis.; I. Ivan, Whiting

• PROGRAM PERSONALITIES •

R. W. Parsons

J. A. Duma

L. Brown

A. E. Schuh

G. Vennerholm

J. E. Fifield

J. E. Rehder

W. B. McFerrin

R. J. Anderson

K. H. Priestley

E. Johnson

J. S. Vanick

C. V. Nass

T. E. Eagan

M. J. Gregory

G. J. Barker

R. J. Fisher

L. J. Ebert

S. W. Brinson

H. E. Flanders

J. B. Caine

A. F. Pfeiffer

J. H. Schaum

E. L. Thomas

W. H. Baer

A. M. Fulton

F. L. Wolf

52nd PROGRAM

MONDAY, MAY 3 *(Cont.)*

Corp., Harvey, Ill.; Glenn Kies, Industrial Training Service, Detroit; H. L. Rosse, Eddystone Borough Schools, Pa.; F. B. Skeates, Link Belt Co., Chicago; R. S. Tour, University of Cincinnati, Cincinnati.

10:00 AM (C)—Malleable

(Sponsored by Malleable Division)

Presiding—C. F. Lauenstein, Link Belt Co., Indianapolis.

Co-Chairman—W. D. McMillan, International Harvester Co., Chicago.

"Effect of the Common Alloying Elements on the Tensile Properties of Malleable Iron"—H. A. Schwartz and W. K. Bock, National Malleable & Steel Castings Co., Cleveland.

"The Construction and Operation of an Oil-Fired Malleable Iron Holding Furnace"—F. Coghlin, Jr., Albion Malleable Iron Co., Albion, Mich.

"Influence of Chromium on the Graphitization of White Cast Iron"—Gabriel Joly, Technical Center of Foundry Industries, Paris, France—FRENCH EXCHANGE PAPER, presented by C. O. Burgess, Union Carbide & Carbon Research Labs., Niagara Falls, N.Y.

12:00 Noon—Brass and Bronze Round Table Luncheon

(Sponsored by Brass and Bronze Division)

Presiding—B. A. Miller, Baldwin Locomotive Works, Eddystone, Pa.

Co-Chairman—R. J. Keeley, Ajax Metals, Philadelphia.

Subject—*"Recent Developments in the Melting of Brass and Bronze."*

Discussion Leader—H. L. Smith, Federated Metals Div., American Smelting & Refining Co., Pittsburgh.

2:00 PM (A)—Aluminum and Magnesium

(Sponsored by Aluminum and Magnesium Division)

Presiding—C. E. Nelson, Dow Chemical Co., Midland, Mich.

Co-Chairman—M. H. Young, Wright Aeronautical Corp., Wood Ridge, N.J.

"Can Castings Be Engineered?"—F. G. Tatnall, Baldwin Locomotive Works, Eddystone, Pa.

"Effect of Design on the Serviceability of Light Metal Alloy Castings"—G. L. Moore, Aluminum Co. of America, Cleveland.

52nd PROGRAM

MONDAY, MAY 3 *(Cont.)*

2:00 PM (B)—Malleable

(Sponsored by Malleable Division)

Presiding—C. F. Joseph, Central Foundry Div., General Motors Corp., Saginaw, Mich.
Co-Chairman—Eric Welander, Union Malleable Iron Works, Deere & Co., East Moline, Ill.
"*Application of Correlation in the Malleable Iron Industry*"—R. G. Seidel, National Malleable & Steel Castings Co., Cleveland.
"*Production Hardness Testing in a Malleable Shop*"—C. Schneider and L. Ulsenheimer, National Malleable & Steel Castings Co., Cleveland.

4:00 PM (A)—Brass and Bronze

(Sponsored by Brass and Bronze Division)

Presiding—H. M. St. John, Crane Co., Chicago.
Co-Chairman—J. J. Curran, Walworth Co., Greensburg, Pa.
"*An Approach to Quality Control in Casting Production*"—G. K. Eggleston and V. A. Simpson, Barnes Mfg. Co., Mansfield, Ohio.
"*Ingot Metal vs. Virgin Metal*"—F. L. Wolf, Mansfield, Ohio.

4:00 PM (B)—Lecture Course

(Sponsored by Annual Lecture Committee)

Presiding—M. E. Brooks, Dow Chemical Co., Bay City, Mich.
Co-Chairman—D. Basch, Almin Ltd. of Great Britain, Schenectady, N.Y.
Subject—"*Test Procedures for Quality Control of Aluminum and Magnesium Castings.*"
Lecturer—E. V. Blackmun, Aluminum Co. of America, Cleveland.

6:30 PM—Educational Dinner

(Sponsored by Educational Division)

Presiding—A. W. Gregg, Whiting Corporation, Harvey, Ill.
Co-Chairman—D. F. Lane, Bethlehem Steel Co., Sparrows Point ,Md.
Subject—"*Management's View of Foundry Educational Activities.*"
Discussion Leader—M. J. Gregory, Peoria.

8:00 PM (A)—Gray Iron Shop Course

(Sponsored by Gray Iron Shop Course Committee)

Presiding—E. J. Burke, Hanna Furnace Co., Buffalo.


D. F. Sawtelle


W. C. Wick


E. Woodliff


F. J. Dost

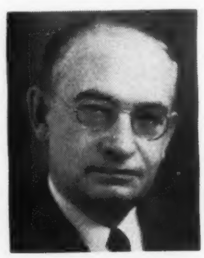

M. A. Mierecke


F. S. Brewster


F. G. Sefing

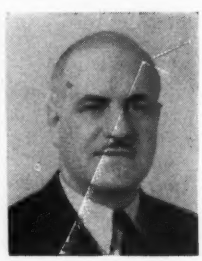

J. A. Bowers


N. J. Dunbeck


H. M. St. John

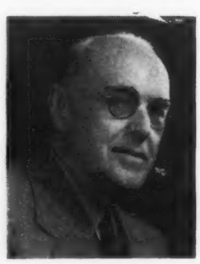

J. A. Rassenfoss


R. J. Keeley


C. E. Westover


H. H. Fairfield


W. D. McMillan


E. W. Beach


G. K. Dreher


H. H. Wilder

M. H. Young

E. C. Jeter

C. O. Burgess

H. W. Dietert

W. H. Johnson

A. I. Krynitsky

R. H. Koch

T. Curry

H. H. Johnson

R. L. Lee

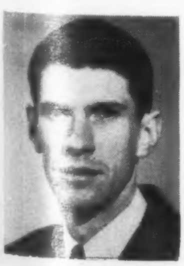
L. B. Knight

L. W. Eastwood

A. K. Higgins

R. Schneidewind

B. A. Miller



M. E. Gantz

R. H. Jacoby

W. E. Sicha

52nd PROGRAM

MONDAY, MAY 3 *(Cont.)*

Co-Chairman—A. N. Kraft, Wilkening Mfg. Co., Philadelphia.

Subject—*"Front Slagging of the Cupola."*

Discussion Leader—T. W. Curry, Lynchburg Foundry Co., Lynchburg, Va.

8:00 PM (B)—Sand Shop Course

(Sponsored by Sand Shop Course Committee)

Presiding—R. F. Thomson, International Nickel Co., Detroit.

Co-Chairman—C. A. Sanders, American Colloid Co., Chicago.

Subject—*"Non-Ferrous Foundry Sands."*

Discussion Leader—J. J. Shannon, Jenkins Bros., Bridgeport, Conn.

TUESDAY, MAY 4

10:00 AM (A)—Aluminum and Magnesium

(Sponsored by Aluminum and Magnesium Division)

Presiding—H. Brown, Solar Aircraft Co., Des Moines, Iowa.

Co-Chairman—H. R. Youngkrantz, Apex Smelting Co., Chicago.

"Aluminum-Zinc-Magnesium-Copper Casting Alloys"—L. W. Eastwood, Battelle Memorial Institute, Columbus, and L. W. Kempf, deceased, formerly with Aluminum Co. of America, Cleveland.

"Effect of Titanium on Grain Size and Tensile Properties of an Aluminum 4.5% Cu (No. 195) Casting Alloy"—W. E. Sicha and R. C. Boehm, Aluminum Co. of America, Cleveland.

"A Fluidity Test for Aluminum Casting Alloys"—W. E. Sicha and R. C. Boehm, Aluminum Co. of America, Cleveland.

10:00 AM (B)—Brass and Bronze

(Sponsored by Brass and Bronze Division)

Presiding—R. M. Brick, University of Pennsylvania, Philadelphia.

Co-Chairman—C. A. Robeck, Gibson & Kirk Co., Baltimore, Md.

"The Technology of Copper-Lead Alloys"—R. W. K. Honeycombe, Melbourne, Australia, INSTITUTE OF AUSTRALIAN FOUNDRYMEN EXCHANGE PAPER. Presented by Wm. Ball, Jr., Magnus Brass Div., National Lead Co., Cincinnati.

"The Effect of Foundry Practice on the Properties of

PROGRAM 52nd

TUESDAY, MAY 4 *(Cont.)*

Some Binary Copper-Silicon Alloys"—A. I. Krynitsky, W. P. Saunders, and H. Stern, National Bureau of Standards, Washington, D.C.

10:00 AM (C)—Malleable

(Sponsored by Malleable Division)

Presiding—G. A. Vennerholm, Ford Motor Co., Dearborn, Mich.

Co-Chairman—W. B. McFerrin, Electro Metallurgical Co., Detroit.

"Effect of Manganese Sulphur Ratio on the Rate of Anneal of Blackheart Malleable Iron"—J. E. Rehder, Bureau of Mines, Ottawa, Canada.

"Pearlitic Malleable Irons, Plain and Alloyed"—D. J. Reese, International Nickel Co., New York, and Richard Schneidewind, University of Michigan, Ann Arbor, Mich.

12:00 Noon (A)—Aluminum and Magnesium Round Table Luncheon

(Sponsored by Aluminum and Magnesium Division)

Presiding—W .J. Klayer, Aluminum Industries Inc., Cincinnati.

Co-Chairman—M. E. Gantz, American Magnesium Co., Cleveland.

"The Development of a Permanent Mold for Aluminum Tensile Test Bars"—L. J. Ebert, R. E. Spear, and G. Sachs, Case Institute of Technology, Cleveland.

Discussion—*"Permanent Mold Casting of Aluminum and Magnesium Alloys."*

12:00 Noon (B)—Malleable Round Table Luncheon

(Sponsored by Malleable Division)

Presiding—J. H. Lansing, Malleable Founders' Society, Cleveland.

Co-Chairman—A. M. Fulton, Northern Malleable Iron Co., St. Paul, Minn.

Subject—*"Malleable Foundry Mechanization."*

Discussion Leader—R. J. Anderson, Belle City Malleable Iron Co., Racine, Wis.

2:00 PM (A)—Brass and Bronze

(Sponsored by Brass and Bronze Division)

Presiding—R. W. Parsons, Ohio Brass Co., Mansfield, Ohio.

Co-Chairman—A. K. Higgins, Allis-Chalmers Mfg. Co., Milwaukee.


A. Boyles


R. E. Morey


H. F. Taylor


F. J. Walls


D. Zuege


H. L. Smith


J. H. Lansing


B. P. Mulcahy


G. Sachs


W. W. Levi


R. J. Healy


H. Brown


J. D. Wozny


E. V. Blackmun


V. Paschkis


H. L. Campbell


V. A. Crosby


A. S. Klopf

"*A New Permeable Metal Casting Plaster*"—K. A. Miericke and E. S. Johnson, U. S. Gypsum Co., Chicago.
"*The Value of Pressure Tests and Radiographs of Gun Metal Castings*"—W. H. Baer, Naval Research Laboratory, Washington, D.C.

2:00 PM (B)—Heat Transfer

(Sponsored by Heat Transfer Committee)

Presiding—E. C. Troy, National Engineering Co. Philadelphia.
Co-Chairman—H. F. Taylor, Massachusetts Institute of Technology, Cambridge, Mass.
"*Heat Transfer Committee Report*"—H. A. Schwartz, *Chairman,* National Malleable and Steel Castings Co., Cleveland.
"*Thermal Conductivity of a Sand Mixture*"—C. F. Lucks, O. L. Linebrink, and K. L. Johnson, Battelle Memorial Institute, Columbus, Ohio.
"*Studies of Solidification of Aluminum Castings*"—
"*Studies of Solidification of White Iron Castings*"—
"*A Study of Solidification of Steel Spheres*"—
all by V. Paschkis, Columbia University, New York.

2:00 PM (C)—Pattern

(Sponsored by Pattern Division)

Presiding—A. F. Pfeiffer, Allis-Chalmers Mfg. Co., Milwaukee.
Co-Chairman—L. F. Tucker, City Pattern & Foundry Co., South Bend, Ind.
"*Core Box Design and Rigging for Core Blowing*"—H. J. Jacobson, Industrial Pattern Works, Chicago.
"*Metallizing Wood Patterns*"—H. A. Erbe, General Steel Casting Co., Granite City, Ill.

4:00 PM (A)—Lecture Course

(Sponsored by Annual Lecture Committee)

Presiding—C. A. Robeck, Gibson & Kirk Co., Baltimore, Md.
Co-Chairman—W. W. Edens, Badger Brass & Aluminum Foundry, Milwaukee.
Subject—"*Test Procedures for Quality Control of Sand Castings—Brass, Bronze, and Nickel Alloys.*"
Lecturer—Wm. Romanoff, H. Kramer & Co., Chicago.

4:00 PM (B)—Lecture Course

(Sponsored by Annual Lecture Committee)

Presiding— H. N. Whitemore, National Malleable & Steel Castings Co., Cleveland.
Co-Chairman—Milton Tilley, National Malleable and Steel Castings Co., Cleveland.
Subject—"*Test Procedures for Quality Control of Malleable Iron Castings.*"
Lecturer—M. O. Booth, Central Foundry Div., General Motors Corp., Saginaw, Mich.

7:00 PM—Chapter Officers and Directors Dinner
Presiding—W. B. Wallis, Vice-President, American Foundrymen's Association.

8:00 PM (A)—Plant and Plant Equipment

(Sponsored by Plant and Plant Equipment Committee)

Presiding—James Thomson, Continental Foundry & Machine Co., East Chicago, Ind.

Co-Chairman—E. W. Beach, Campbell Wyant & Cannon Foundry Co., Muskegon, Mich.
"*Modernization of the Small Foundry*—L. B. Knight, L. B. Knight & Assoc., Inc., Chicago.

8:00 PM (B)—Gray Iron Shop Course

(Sponsored by Gray Iron Shop Course Committee)

Presiding—H. H. Wilder, Eaton Mfg. Co., Vassar, Mich.
Co-Chairman—B. A. Miller, Baldwin Locomotive Works, Eddystone, Pa.
Subject—"*Effect of Blast Variation on Cupola Control.*"
Discussion Leader—B. P. Mulcahy, Consultant, Indianapolis, Ind.

8:00 PM (C)—Sand Shop Course

(Sponsored by Sand Shop Course Committee)

Presiding—D. F. Sawtelle, Malleable Iron Fittings Co., Branford, Conn.
Co-Chairman—F. S. Brewster, Harry W. Dietert Co., Detroit.
Subject—"*Malleable Foundry Sands.*"
Discussion Leader—R. P. Schauss, Illinois Clay Products Co., Chicago.

WEDNESDAY, MAY 5

9:30 AM—Annual Business Meeting and Charles Edgar Hoyt Annual Lecture
Presiding—Max Kuniansky, President, American Foundrymen's Association.
President's Annual Address.
Apprentice Contest Awards.
Election of Officers and Directors.
Charles Edgar Hoyt Annual Lecture—"*The Control of Grain Size in Magnesium Castings*"—C. E. Nelson, Dow Chemical Co., Midland, Mich.

12:00 Noon (A)—Engineering School Graduates Luncheon

(Sponsored by Educational Division)

Presiding—H. H. Judson, Minneapolis Moline Power Implement Co., Minneapolis, Minn.
Co-Chairman—C. V. Nass, Pettibone-Mulliken Corp.
"*Engineering Education*"—R. M. Brick, University of Pennsylvania, Philadelphia.

12:00 Noon (B)—Pattern Round Table Luncheon

(Sponsored by Pattern Division)

Presiding—L. F. Tucker, City Pattern & Foundry Co., Inc., South Bend, Ind.

52nd PROGRAM

WEDNESDAY, MAY 5 *(Cont.)*

Co-Chairman—H. K. Swanson, Swanson Pattern & Model Works, East Chicago, Ind.

Subject—*"Patternmaking."*

Discussion Leader—Martin Rintz, Continental Foundry & Machine Co., East Chicago, Ind.

2:00 PM (A)—Gray Iron

(Sponsored by Gray Iron Division)

Presiding—V. A. Crosby, Climax Molybdenum Co., Detroit.

Co-Chairman—D. E. Krause, Gray Iron Research Institute, Columbus, Ohio.

"Relation of Cupola Research to Progress in Cast Iron Development"—R. G. McElwee, Vanadium Corporation of America, Detroit.

"A Suggested Method for the Determination of Coke Reactivity to Carbin Dioxide at Combustion Temperatures"—H. E. Flanders, University of Utah, Salt Lake City.

2:00 PM (B)—Refractories

(Sponsored by Refractories Committee)

Presiding—R. H. Stone, Vesuvius Crucible Co., Swissvale, Pa.

Co-Chairman—A. S. Klopf, Western Foundry Co., Chicago.

"Testing Refractories for the Foundry"—S. M. Swain, North American Refractories Co., Cleveland.

"Review of Refractories Used in Iron and Steel Foundries"—William H. Owen, Harbison Walker Refractories Co., Pittsburgh.

4:00 P M (A)—Lecture Course

(Sponsored by Annual Lecture Committee)

Presiding—G. A. Vennerholm, Ford Motor Co., Dearborn, Mich.

Co-Chairman—F. J. Dost, Sterling Foundry Co., Wellington, Ohio.

Subject—*"Test Procedures for Quality Control of Gray Iron Castings."*

Lecturer—F. J. Walls, International Nickel Co., Detroit.

4:00 PM (B)—Sand

(Sponsored by Sand Division)

Presiding—E. C. Troy, National Engineering Co. Philadelphia.

Co-Chairman—Werner Finster, Reading Steel Casting Div., American Chain & Cable Co., Reading.

"Surface Gas Pressure of Molding Sands and Core Sands"—H. W. Dietert, H. H. Fairfield, and F. S. Brewster, Harry W. Dietert Co., Detroit.

"Changes in Chemistry of Liquid Steel in Contact with Sand"—Report of Mold Surface Committee, J. B. Caine, *Chairman,* Sawbrook Steel Castings Co., Lockland, Ohio.

"Sieve and Grade Scales"—R. E. Morey, Naval Research Laboratory, Washington, D.C.

7:00 PM—Canadian Dinner

Presiding—E. N. Delahunt, Warden King Ltd., Montreal, Canada.

8:00 PM (A)—Refractories

(Sponsored by Refractories Committee)

Presiding—A. S. Klopf, Western Foundry Co., Chicago.

Co-Chairman—C. F. Joseph, Central Foundry Div., General Motors Corp., Saginaw, Mich.

Question and Answer Panel—*"Information Please."*

8:00 PM (B)—Gray Iron Shop Course

(Sponsored by Gray Iron Shop Course Committee)

Presiding—W. W. Levi, Lynchburg Foundry Co., Radford, Va.

Co-Chairman—C. L. Lane, Florence Pipe Foundry & Machine Co., Florence, N.J.

Subject—*"Cupola Coke."*

Discussion Leader—J. A. Bowers, American Cast Iron Pipe Co., Birmingham, Ala.

8:00 PM (C)—Sand Shop Course

(Sponsored by Sand Shop Course Committee)

Presiding—E. L. Thomas, Cadillac Motor Car Company, Detroit.

Co-Chairman—N. J. Dunbeck, Eastern Clay Products Inc., Jackson, Ohio.

Subject—*"Gray Iron Foundry Sands."*

Discussion Leader—T. W. Curry, Lynchburg Foundry Co., Lynchburg, Va.

THURSDAY, MAY 6

10:00 AM (A)—Gray Iron

(Sponsored by Gray Iron Division)

Presiding—A. E. Schuh, U. S. Pipe & Foundry Co., Burlington, N.J.

Co-Chairman—F. G. Sefing, International Nickel Co., New York.

"A Laboratory Evaluation of Some Automotive Cast Irons"—A. B. Shuck, Koppers Co., Inc., American Hammered Piston Ring Div., Baltimore, Md.

"Contraction and Distortion in Ferrous Castings"—E. Longden, P. R. Jackson & Co. Ltd., Manchester, England—INSTITUTE OF BRITISH FOUNDRYMEN EXCHANGE PAPER.

10:00 AM (B)—Job Evaluation and Time Study

(Sponsored by Job Evaluation and Time Study Committee)

Presiding—R. J. Fisher, The Falk Corp., Milwaukee.

Co-Chairman—M. E. Annich, American Brake Shoe Co., Mahwah, N.J.

E. C. Troy

R. H. Stone

G. A. Lillieqvist

A. W. Gregg

E. C. Zirzow

W. D. Ball

D. J. Reese

J. T. MacKenzie

J. Thomson

E. L. LaGrelius

H. K. Swanson

V. E. Zang

W. Romanoff

D. F. Lane

A. T. Ruppe

C. E. Locke

R. E. Spear

W. W. Austin, Jr.

THURSDAY, MAY 6 *(Cont.)*

"Grinding Standards Help to Eliminate Cleaning Room Bottlenecks"—Dean Van Order, Burnside Steel Foundry Co., Chicago.

10:00 AM (C)—Steel

(Sponsored by Steel Division)

Presiding—W. W. Moore, Burnside Steel Foundry Co., Chicago.

Co-Chairman—H. F. Taylor, Massachusetts Institute of Technology, Cambridge, Mass.

"Observations on Knock-Off Risers as Applied to Steel Castings"—J. A. Duma and S. W. Brinson, Norfolk Naval Shipyard, Portsmouth, Va.

"A Theoretical Approach to the Problem of Dimensioning Risers"—J. B. Caine, Sawbrook Steel Castings Co., Lockland, Ohio.

12:00 Noon—Steel Round Table Luncheon

(Sponsored by Steel Division)

Presiding—J. A. Duma, Norfolk Naval Shiypard, Portsmouth, Va.

Co-Chairman—J. A. Rassenfoss, American Steel Foundries, East Chicago, Ind.

Motion Picture—*"Gating Systems for Metal Casting"*—Wm. H. Johnson and Wm. O. Baker, Naval Research Lab., Washington, D.C.

Followed by discussion.

2:00 PM (A)—Foundry Cost

(Sponsored by Cost Committee)

Presiding—R. L. Lee, Grede Foundries Inc., Milwaukee.

Co-Chairman—C. E. Westover, Westover Engineers, Milwaukee.

"Question and Answer Panel"—Cost problems of general interest, method of cost accounting, distribution of costs, etc.

2:00 PM (B)—Gray Iron. (Symposium on Heat Treatment of Gray Cast Iron)

(Sponsored by Gray Iron Division)

Presiding—J. S. Vanick, International Nickel Co., New York.

Co-Chairman—T. E. Eagan, Cooper Bessemer Corp., Grove City, Pa.

Comments on Symposium—G. A. Timmons, Climax Molybdenum Co., Detroit.

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THURSDAY, MAY 6 *(Cont.)*

"Fundamentals of Heat Treating Gray Cast Iron"—A. Boyles, U. S. Pipe & Foundry Co., Burlington, N.J.

"Gray Iron Hardenability and Its Relation to Air Quenching of Castings"—R. A. Flinn and R. J. Ely, American Brake Shoe Co., Mahwah, N.J.

4:00 PM (A)—Lecture Course

(Sponsored by Annual Lecture Committee)

Presiding—G. A. Lillieqvist, American Steel Foundries, East Chicago, Ind.

Co-Chairman—C. H. Lorig, Battelle Memorial Institute, Columbus, Ohio.

Subject—*"Test Procedures for Quality Control of Steel Castings."*

Lecturer—J. W. Juppenlatz, Lebanon Steel Foundry, Lebanon, Pa.

4:00 PM (B)—Gray Iron. (Symposium on Heat Treatment of Gray Cast Iron)

(Sponsored by Gray Iron Division)

Presiding—H. Bornstein, Deere & Co., Moline, Ill.

Co-Chairman—D. A. Paull, Sealed Power Corp., Muskegon, Mich.

"Stress Relief of Gray Iron Castings"—J. H. Schaum, Naval Research Laboratory, Washington, D.C.

"Conventional vs. Salt Bath Hardening of Cast Iron Cylinder Liners"—G. Lahr, Detroit Diesel Engine Div., General Motors Corp., Detroit.

4:00 PM (C)—Sand

(Sponsored by Sand Division)

Presiding—J. A. Rassenfoss, American Steel Foundries, East Chicago, Ind.

Co-Chairman—E. C. Zirzow, National Malleable & Steel Castings Co., Cleveland.

"Progress Report on High Temperature Properties of Steel Molding Sands"—P. E. Kyle, Cornell University, Ithaca, New York.

"Strainer Cores"—H. L. Campbell, Western Foundry Co., Chicago.

"Causes of Rat-Tail Casting Defects"—Report of A.F.A. Committee on Physical Properties of Iron Foundry Molding Materials at Elevated Temperatures, H. W. Dietert, *Chairman,* Harry W. Dietert Co., Detroit.

4:00 PM (D)—Job Evaluation and Time Study

(Sponsored by Job Evaluation and Time Study Committee)

Presiding—R. J. Fisher, The Falk Corp., Milwaukee.

Co-Chairman—M. E. Annich, American Brake Shoe Co., Mahwah, N.J.

Question and Answer Panel.

7:00 PM—A.F.A. Alumni Dinner

8:00 PM (A)—Gray Iron Shop Course

(Sponsored by Gray Iron Shop Course Committee)

Presiding—K. H. Priestley, Vassar Electroloy Products, Inc., Vassar, Mich.

Co-Chairman—Ralph Koch, U. S. Pipe Foundry Co., Burlington, N.J.

Subject—*"Factors Affecting Fluidity of Cupola Iron."*

Discussion Leader—R. F. Flora, Clover Foundry, Muskegon, Mich.

8:00 PM (B)—Sand Shop Course

(Sponsored by Sand Shop Course Committee)

Presiding—R. H. Jacoby, Key Co., East St. Louis, Ill.

L. F. Tucker

C. F. Joseph

R. F. Thompson

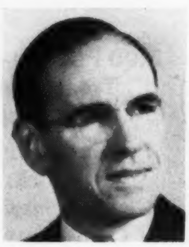
H. A. Erbe

R. G. Seidel

R. C. Boehm

C. A. Schneider

R. A. Flinn



V. A. Simpson

I. Ivan

H. Stern

H. Bornstein

Co-Chairman—E. E. Woodliff, Foundry Sand Service Engineering Co., Detroit.
Subject—"*Steel Foundry Sands.*"
Discussion Leader—Charles Locke, Armour Research Foundation, Chicago.

FRIDAY, MAY 7

10:00 AM (A)—Gray Iron.

(Sponsored by Gray Iron Division)

Presiding—J. T. MacKenzie, American Cast Iron Pipe Co., Birmingham, Ala.
Co-Chairman—W. W. Levi, Lynchburg Foundry Co., Radford, Va.
"*Improvement of Machinability in High Phosphorus Gray Cast Irons*"—W. W. Austin, Jr., Southern Research Institute, Birmingham, Ala.
"*The Production of Nodular Graphite Structure in Gray Cast Iron*"—H. Morrogh, British Cast Iron Research Assn., Alvechurch, England.

10:00 AM (B)—Steel.

(Sponsored by Steel Division)

Presiding—Frank Kiper, Ohio Steel Foundry, Springfield, Ohio.
Co-Chairman—V. E. Zang, Unitcast Corporation, Toledo, Ohio.
"*Tensile Properties vs. Composition of Double Normalized Cast Steel*"—W. K. Bock and H. A. Schwartz, National Malleable & Steel Casting Co., Cleveland.
"*The Delayed Quench for Steel Castings*"—S. L. Gertsman, Bureau of Mines, Ottawa, Canada.
"*Electro-Chemical Cleaning of A Large Steel Casting—An Experiment*"—J. A. Wettergreen, General Electric Co., Schenectady, N.Y.

2:00 PM (A)—Gray Iron.

(Sponsored by Gray Iron Division)

Presiding—R. G. McElwee, Vanadium Corp. of America, Detroit.
Co-Chairman—E. C. Jeter, Ford Motor Co.

"*Oxygen Enriched Cupola Blast*"—W. C. Wick, Armour Research Foundation, Chicago.
"*Solidification Characteristics of Gray Iron*"—J. H. Schaum, Naval Research Lab., Washington, D.C. and J. E. Fifield, International Nickel Co., Hartford, Conn.

2:00 PM (B)—Steel.

(Sponsored by Steel Division)

Presiding—J. F. Randall, Ford Motor Co., Detroit.
Co-Chairman—D. C. Zuege, Sivyer Steel Casting Co., Milwaukee.
"*Statistical Quality Control—A New Tool for the Foundryman*"—H. H. Johnson and G. A. Fisher, National Malleable & Steel Castings Co., Sharon, Pa.
"*Development of Techniques for Quality Welding of Steel Castings*"—J. D. Wozny and E. L. LaGrelius, American Steel Foundries, East Chicago, Ind.

7:00 PM—Annual Banquet.

Presiding—Max Kuniansky, President, A.F.A.
Presentation of A.F.A. Gold Medal Awards and Honorary Life Memberships.
Speaker—Dr. Karl Taylor Compton, President, Massachusetts Institute of Technology, Cambridge, Mass.
Subject—"*Team Play of Hand and Brain.*"


D. A. Paull


W. H. Ruten


G. M. Lahr


W. O. Baker


E. J. Vargo


R. M. Brick


A. B. Shuck


F. G. Tatnall


H. J. Jacobson

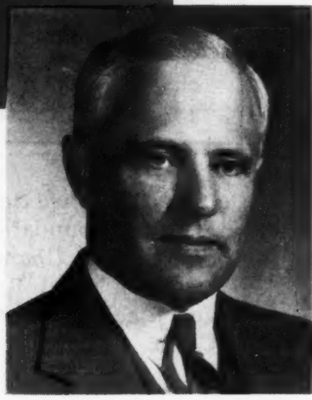

F. Kiper


C. A. Robeck


H. L. Rosse

CONVENTION SPEAKER

52nd



KARL T. COMPTON TO ADDRESS AFA ANNUAL BANQUET

"TEAM PLAY OF HAND AND BRAIN" is the topic of Dr. Karl Taylor Compton, president of Massachusetts Institute of Technology, Cambridge, guest speaker at the 1948 Annual Banquet of A.F.A. in Philadelphia, May 7.

The subject he will discuss before members of the Association at the climax of the 52nd Annual Meeting summarizes Dr. Compton's conception of the basic factor in the advance of civilization. He has given generously of his time in public services, and has often stated his conviction that education in science and engineering, combined with an understanding of the social implications of developments in those professions, is the best basis for industrial and social progress.

Head of MIT since 1930, and a participant in developments of national and international significance for many years, Dr. Compton is an outstanding scientist, educator, administrator and humanitarian.

He was honored with the Marcellus Hartley medal of the National Academy of Sciences last year for "eminence in the application of science to public welfare," and had previously (in 1931) received the Rumford medal, one of the most distinguished of all scientific awards, for studies in the field of spectroscopy and thermionic emission.

Dr. Compton had a leading role in directing the application of science to the war effort during the recent conflict, and has since played a similar part in its direction to industrial recovery. A member of the War Resources Board in 1939-40, he was appointed to the National Defense Research Committee of the Office of Scientific Research and Development in the latter year, serving through 1945. He served on the Baruch Rubber Survey Committee in 1942, was chairman of the Radar Committee of the Joint Committee on New Weapons of the Joint Chiefs of Staff from 1942 to 1945, and was a member of the Advisory Staff of the Chief of Ordnance Military Training for the same period.

Chairman of the U. S. Radar Mission to the United Kingdom in 1943, Dr. Compton was also appointed chief of the Office of Field Service of the Office of Scientific Research and Development that year. He was named to the Committee on Post-War Research and Development of the Secretaries of War and Navy.

A member of the Secretary of War's Special Advisory Committee on the Atomic Bomb, he was appointed to President Truman's personal committee on the atomic bomb test in 1946 and also to the Evaluation Board on the Atomic Bomb Tests of the Joint Chiefs of Staff.

His most recent public services include membership on the Advisory Commission on Military Training and the National Council of the Committee for the Marshall Plan to Aid European Recovery. Last year he headed the nine-man All-Civilian Committee on Universal Military Training.

Dr. Compton is a member of a family distinguished in the field of education: the son of the late Elias A. Compton, for many years dean and professor of philosophy at the College of Wooster (Ohio); and brother of Dr. Arthur H. Compton, chancellor of Washington University, St. Louis; Dr. Wilson M. Compton, president of Washington State College, Pullman; and Mrs. Charles Herbert Rice, wife of the president of Foreman Christian College, Lahore, India.

As an educator, Dr. Compton has sought to combine, in the belief that the aim of all education is a culture based on sympathetic understanding and appreciation of life, the precise knowledge of the professions with studies of broad human significance. He has said that municipal, state and Federal governments offer technically trained men broad opportunities for raising the standards of public service.

Research of the future, according to Dr. Compton, must concern not only new discoveries, but the development of new industries based on the work of scientists and engineers. In this, he sees prospects for new products and increased employment.

It is the responsibility of institutions of higher learning, he has said, to impart to the minds of the leaders of tomorrow a rigorous intellectual honesty, a reverence for truth, an open-minded approach to new situations, and a balanced judgment..

C. E. NELSON TO DELIVER ANNUAL HOYT LECTURE

Charles E. Nelson, technical director of the magnesium division of Dow Chemical Co., Midland, Mich., will deliver the second Charles Edgar Hoyt Annual Lecture at the business session of the 1948 Congress and Show, Wednesday morning in Convention Hall.

His discussion of "The Control of Grain Growth in Magnesium Castings" will be one of the technical program highlights of the 52nd Annual Meeting.

Selection of Mr. Nelson as the 1948 lecturer by the Annual Lecture Committee was in the tradition of the series—begun in 1938—to bring to the annual assembly of A.F.A. members a discussion of an important phase of foundry technology by an authority in the field.

Long and well known to the Association, Mr. Nelson has served on many of its national technical groups. He is at present a member of the Executive Committee, Aluminum and Magnesium Division; Chairman of the division's Committee on Design and Stress Analysis, and a member of its Research, Die Casting, and Shrinkage and Porosity committees.

A member of the executive body of the light metals group since its formation as an A.F.A. Division, he has also served as head of the Yield Strength Committee, and been associated with investigations of permanent mold, plaster and centrifugal casting.

Author of numerous technical papers on magnesium technology, Mr. Nelson has contributed to the trade and technical press, as well as to meetings of the Association and of other scientific groups. He holds membership in A.F.A., ACS, AIME and ASM.

A native of Nelsonville, O., Mr. Nelson was graduated by Alma (Mich.) College in 1928. That year he joined Chevrolet Motor Co. at Flint, Mich., as a metallurgical chemist. He remained there until 1929, and spent the following year with E. I. du Pont De Nemours & Co. as a research chemist at the Wilmington, Del., experimental station.

Joining the magnesium staff of Dow Chemical at Midland as a research metallurgist in 1930, he served in that capacity until 1937, when he advanced to chief of the metallurgical staff. He was named to the post of assistant director of metallurgical research in 1941, and to his present position in 1946.

A.F.A.'s annual lectureship, one of its highest honors, was established in 1937. The first in the series, then known as the "Awards Lecture," was presented at Cleveland in 1938 by C. R. Hook, president of American Rolling Mill Co., Middletown, Ohio.

In 1942, the lecture was designated the "Foundation Lecture," and in 1946 it was renamed in honor of C. E. Hoyt, who retired that year after being associated with A.F.A. for nearly thirty years.

The first Charles Edgar Hoyt lecture was delivered at the Convention of last year in Detroit, by Dr. James T. MacKenzie, chief metallurgist and a director of American Cast Iron Pipe Co., Birmingham, Ala.

Excerpts from Foundation Lectures

"The objective of the Association is to encourage the assembly of technical information and to disseminate it . . . to promote improvements in products and processes, and to see that the engineering world has placed before it reliable and complete information". **—J. W. Bolton, 1943.**

"We live by pouring liquid metal into the molds and selling the solidified object to the customer . . . the foundryman must be concerned with the question of producing a frozen piece of metal having a desired form, free from injurious voids, and of a microstructure and macrostructure consistent with certain desired physical properties." **—H. A. Schwartz, 1945.**

"Granted good construction, adequate blowing equipment, with pressure gages and volume—all readily available today—a good refractory lining is of the first concern of the melter . . . proper sizing of scrap and pig is important . . . usually by varying the blast almost any coke can be made to produce hot iron . . . plenty of stone is usually a saving both in operating smoothness and in cupola cleanliness." **—James T. Mackenzie, 1947.**

Ladies Entertainment

FOUR MEMORABLE DAYS packed with colorful, exciting events have been arranged for the ladies who will attend A.F.A.'s 52nd Annual Meeting by the Philadelphia Chapter Ladies Entertainment Committee, headed by H. J. Williams, New Jersey Silica Sand Co., Millville, N.J. and Mrs. Williams.

Registration headquarters for the ladies will be maintained at the Bellevue-Stratford Hotel, and will be manned Monday through Thursday by members of the host committee, which includes Mrs. E. C. Benkert, Mrs. W. D. Bryden, Miss Irene Gocher, Mrs. K. S. Matz, Mrs. C. W. Mooney, Mrs. C. W. Thompson, Miss Dorothea M. Thum and Mrs. M. B. Valentine.

Ladies are urged to register at their earliest convenience after arrival in Philadelphia, in order that provision may be made to accommodate all who wish to participate in the week-long program.

A.F.A. will be host at a reception and tea in the auditorium of John Wanamaker's store Tuesday at 2:30 p.m. Wanamaker's will present a fashion show.

Wednesday morning the ladies will tour historic central Philadelphia, leaving by bus from the Bellevue-Stratford at 9:30 a.m. On the itinerary are some of the shrines of America, scenes of its birth and of some of its most inspiring dramas.

Independence Hall, where the Declaration of Independence, and the Constitution of the United States were signed, houses the Liberty Bell, a symbol of American independence, and one of the most famous castings in the world was poured by Thomas Lister of Whitechapel, London, to celebrate the 50th anniversary of the Commonwealth of Pennsylvania. The bell cracked twice during testing and had to be remelted and recast.

At the site of the signing of the Declaration of Independence, the visitors will be standing in the historic shadow of six famous Colonial foundrymen—signatories to the document. Pennsylvanians James Smith of Cadorus Furnace, and George Ross of Mary Ann Furnace; Charles Carrol, Carrolton Furnace-foundry, Maryland; Stephen Hopkins, Hope Furnace, Rhode Island; Philip Livingstone, Ancram Creek Furnace, New York; George Taylor, Union Furnace of New Jersey, today Taylor-Wharton Iron & Steel Co.

Also on the route are Betsy Ross House, where the first flag of our country was made; the site of Thomas Jefferson's residence; Congress Hall, in which our first Senate and House of Representatives met, and in which Washington and Adams were inaugurated; Carpenter's Hall, Elfreth's Alley, and other famous landmarks.

World-famous Franklin Institute, where "science is fun," will welcome the ladies Wednesday afternoon. Busses to this wonderland of science will leave the Bellevue-Stratford at 1:15 p.m. and guides will be waiting to introduce the visitors to the wonders of the museum. In the Fels Planetarium a special program will be presented.

Here too, foundry industry history was made; for it was in Franklin Institute that three of the five sessions of the first national assemblage of American foundrymen were held. A.F.A.'s initial Convention met there the evening of May 12, 1896, and the morning and afternoon of the following day.

Dr. W. H. Wahl welcomed the A.F.A. delegates to the Institute on behalf of its board of managers, and expressed the hope that the body and the association it met to organize would continue to act in the spirit of "science and progress," the motto, alike, of the foundrymen and of the then 75-year-old Institute.

First technical sessions sponsored by the A.F.A. were conducted in the Institute, and it was there that the report of the Committee on Organization, recommending establishment of the Association, was presented the afternoon of Wednesday, May 13.

It was in the Manufacturers Club, near the 1948 Ladies Headquarters at the Bellevue-Stratford, that A.F.A.'s Constitution was adopted, and that the delegates tendered votes of thanks to these committees that had made possible a successful meeting—including the first "Ladies Committee."

On the 52nd anniversary program for Thursday, May 6, is an all-day motor trip to Valley Forge. Busses will leave the Bellevue-Stratford at 10:00 a.m. and return at 4:00 p.m.

Along the route are the Washington Monument; the log cabin used by General Grant at City Point, Va.; William Penn House, constructed of imported brick in 1683; Haverford College; school of Bryn Mawr, of Quaker fame, and other points of interest.

In Valley Forge itself are Washington Memorial Chapel and Washington's headquarters, National Memorial Arch, Old School House (built by Letitia Penn in 1705), Pennsylvania Columns, the graves of the Unknown Soldiers of Revolutionary days, as well as many of the original buildings—and replicas of others—used by Washington and his troops during the bitter winter of 1777-78.

An historic American furnace-foundry, Mount Joy Forge, was built there in 1742, at which time the locale was known as Earl Valley Creek. It was burned by the British in 1777; later rebuilt it was used in important experiments on crucible steel casting.

On the way back to Philadelphia, the caravan will pass through King of Prussia; Gulph Mills, where Washington camped on his retreat from Germantown to Valley Forge; and Merion Meeting House, founded in 1682 and oldest Quaker place of worship in the State.

The host committee has scheduled no special activities for Friday, May 7. On that day, ladies will be busy shopping and preparing for the climax of A.F.A.'s Convention and Exhibit of 1948—the Annual Banquet in the Grand Ballroom of the Bellevue-Stratford.

At the dinner they will witness the conferral of A.F.A. Gold Medals on outstanding technologists of the modern foundry industry, and will hear the address of the distinguished guest speaker, Dr. Karl Taylor Compton, president of Massachusetts Institute of Technology: "Team Play of Hand and Brain."

PHILADELPHIA — 52nd EXHIBITORS — MAY 3-7

A.F.A. FOUNDRY SHOW . . . 1948

*Accurate Match Plate Co. . . . . . Chicago, Ill.
The Adams Co. . . . . . Dubuque, Iowa
Air Reduction Sales Co. . . . . . New York 17, N.Y.
Ajax Electrothermic Corp. . . . . . Philadelphia, Pa.
Ajax Engineering Co. . . . . . Philadelphia, Pa.
Ajax Flexible Coupling Co. Inc. . . . . . Westfield, N.Y.
Ajax Metal Co. . . . . . Philadelphia, Pa.
Allis-Chalmers Mfg. Co. . . . . . Milwaukee, Wis.
**The Alpha-Lux Company, Inc. . . . . . New York, N.Y.
Aluminum Refiners Div., Bohn Aluminum and Brass Corp. . . . . . Detroit, Mich.
American Air Filter Co., Inc. . . . . . Louisville, Ky.
American Crucible Co. . . . . . North Haven, Conn.
**American Gas Association . . . . . . New York, N.Y.
American Metal Market . . . . . . New York 7, N.Y.
**American Optical Co. . . . . . Southbridge, Mass.
American Steel Abrasives Co. . . . . . Galion, Ohio
American Wheelabrator & Equip. Corp. . . . . . Mishawaka, Ind.
Arcade Mfg. Div. (Rockwell Mfg. Co.) . . . . . . Freeport, Ill.
*Arcos Corporation . . . . . . Philadelphia, Pa.
The Asbury Graphite Mills, Inc. . . Asbury, Warren County, N.J.
Ayers Mineral Co. . . . . . Zanesville, Ohio

*Baroid Sales Div., National Lead Co. . . . . . Los Angeles, Calif.
The C. O. Bartlett & Snow Co. . . . . . Cleveland 5, Ohio
*Bay State Crucible Co. . . . . . Taunton, Mass.
The Beardsley & Piper Co. . . . . . Chicago, Ill.
*Bell Aircraft Corp. . . . . . Buffalo 5, N.Y.
Blaw-Knox Div. of Blaw-Knox Co. . . . . . Blawnox, Pa.
Bloomsbury Graphite Co. . . . . . Bloomsbury, N.J.
Bradley Washfountain Co. . . . . . Milwaukee, Wis.
Buckeye Tools Corp. . . . . . Dayton 1, Ohio
Bullard Gage Co. . . . . . Detroit, Mich.
*Butler Bin Co. . . . . . Waukesha, Wis.

The Campbell-Hausfeld Co. . . . . . Harrison, Ohio
*Capewell Manufacturing Co. . . . . . Hartford, Conn.
*Carlson Pattern Shop, Inc. . . . . . Springfield, Mass.
*Casein Co. of America . . . . . . New York 17, N.Y.
Central Silica Co., Ayers Mineral Co. . . . . . Zanesville, Ohio
Centrifugal Casting Machine Co. . . . . . Tulsa, Okla.
Chain Belt Co. . . . . . Milwaukee 4, Wis.
Champion Foundry & Machine Co. . . . . . Chicago 8, Ill.
Chicago Pneumatic Tool Co. . . . . . New York 17, N.Y.
Chisholm-Moore Hoist Corp. . . . . . Tonawanda, N.Y.
*Christiansen Corp. . . . . . Chicago, Ill.
Clearfield Machine Co. . . . . . Clearfield, Pa.
Clersite Co. . . . . . Chicago, Ill.
The Cleveland Flux Co. . . . . . Cleveland 13, Ohio
Cleveland Metal Abrasive Co. . . . . . Cleveland, Ohio
The Cleveland Vibrator Co. . . . . . Cleveland, Ohio
Climax Molybdenum Co. . . . . . New York 18, N.Y.
*Colonial Smelting & Refining Co. . . . . . Columbia, Pa.
Columbus McKinnon Chain Corp. . . . . . Tonawanda, N.Y.
Combined Supply & Equipment Co. . . . . . Buffalo, N.Y.
Corn Products Sales Co. . . . . . New York, N.Y.

*G. & W. H. Corson, Inc. . . . . . Plymouth Meeting, Pa.
Crescent Machine Div. (Rockwell Mfg. Co.) . . . Leetonia, Ohio

*The Dallet Co. . . . . . Philadelphia, Pa.
Davenport Machine & Foundry Co. . . . . . Davenport, Iowa
**Davey Compressor Co. . . . . . Kent, Ohio
Dayton Oil Co. . . . . . Dayton, Ohio
Dayton Pneumatic Tool Co. . . . . . Dayton, Ohio
**Debevoise-Anderson Co., Inc. . . . . . New York, N.Y.
The Delhi Foundry Sand Co. . . . . . Cincinnati 33, Ohio
Delta Mfg. Div. (Rockwell Mfg. Co.) . . . . . . Milwaukee, Wis.
Delta Oil Products Co. . . . . . Milwaukee, Wis.
Wm. Demmler & Bros. . . . . . Kewanee, Ill.
Despatch Oven Co. . . . . . Minneapolis 14, Minn.
Detroit Elec. Furnace Div., Kuhlman Elec. Co. . . Bay City, Mich
**Diamond Clamp & Flask Co. . . . . . Richmond, Ind.
Harry W. Dietert Co. . . . . . Detroit 4, Mich.
**Dings Magnetic Separator Co. . . . . . Milwaukee, Wis.
Joseph Dixon Crucible Co. . . . . . Jersey City 3, N.J.
The DoAll Co. . . . . . Des Plaines, Ill.
Dougherty Lumber Co. . . . . . Cleveland 5, Ohio
Duquesne Smelting Corp. (American Metal Co. Ltd.) . . . . . . Pittsburgh, Pa.

Eastern Clay Products, Inc. . . . . . Jackson, Ohio
Eastman Kodak Co. . . . . . Rochester 4, N.Y.
Electro Metallurgical Co. (Union Carbide & Carbon Corp.) . . . . . . New York, N.Y.
**Electro Refractories & Alloys Corp. . . . . . Buffalo, N.Y.
*Exomet, Inc. . . . . . Conneaut, Ohio
*Exothermic Alloy Sales & Service Inc. . . . . . Chicago 27, Ill.
Federal Foundry Supply Co. . . . . . Cleveland 5, Ohio
Federated Metals Div. (American Smelting & Refining Co.) . . . . . . New York 5, N.Y.
Fabreeka Products Co. . . . . . Boston 10, Mass.
The Fellows Corp. . . . . . Milwaukee 3, Wis.
Fisher Furnace, Div. of Lindberg Engr. Co. . . . . . Chicago, Ill.
*Foundry Educational Foundation . . . . . . Cleveland, Ohio
The Foundry . . . . . . Cleveland 13, Ohio
The Foundry Equipment Co. . . . . . Cleveland 13, Ohio
Foundry Equipment Manufacturers Assn. . . Cleveland 14, Ohio
The Foxboro Co. . . . . . Foxboro, Mass.
Fox Grinders, Inc. . . . . . Pittsburgh, Pa.
The Freeman Supply Co. . . . . . Toledo 5 ,Ohio
The Fremont Flask Co. . . . . . Fremont, Ohio

*General Cerium Sales Corp. . . . . . Edgewater, N.J.
General Electric X-Ray Corp. . . . . . Milwaukee, Wis.
Globe Steel Abrasive Co. (Pitts. Crushed Steel Co.) . . . . . . Mansfield, Ohio
Gray Iron Founders Society . . . . . . Cleveland, Ohio
Great Lakes Foundry Sand Co. . . . . . Detroit, Mich.
Great Western Mfg. Co. . . . . . Leavenworth, Kan.
Samuel Greenfield Co., Inc. . . . . . Buffalo, N.Y.
**Grob Brothers . . . . . . Grafton, Wis.

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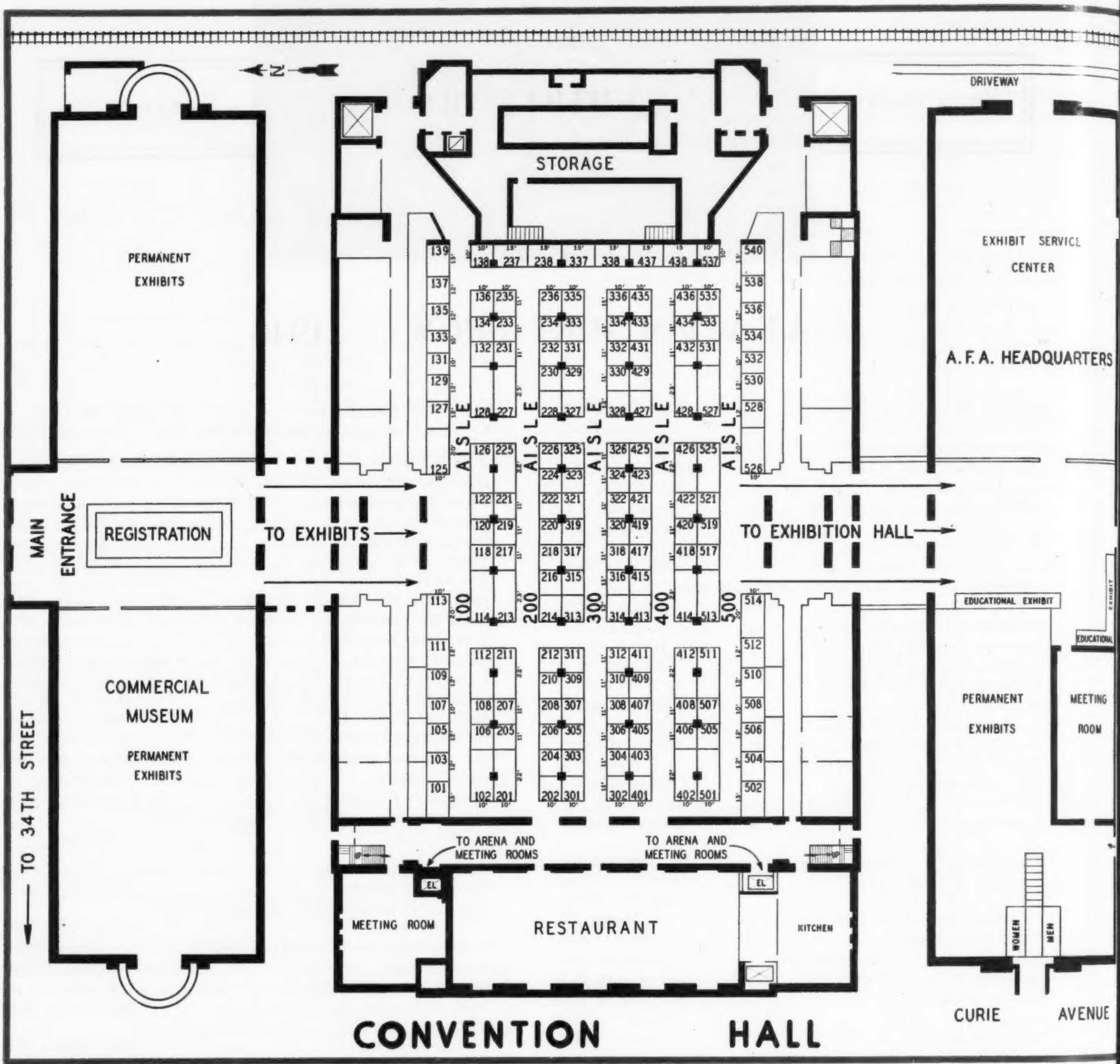
*Have never Exhibited
**Did not Exhibit in 1946

SEE NEXT PAGE FOR FLOOR PLAN

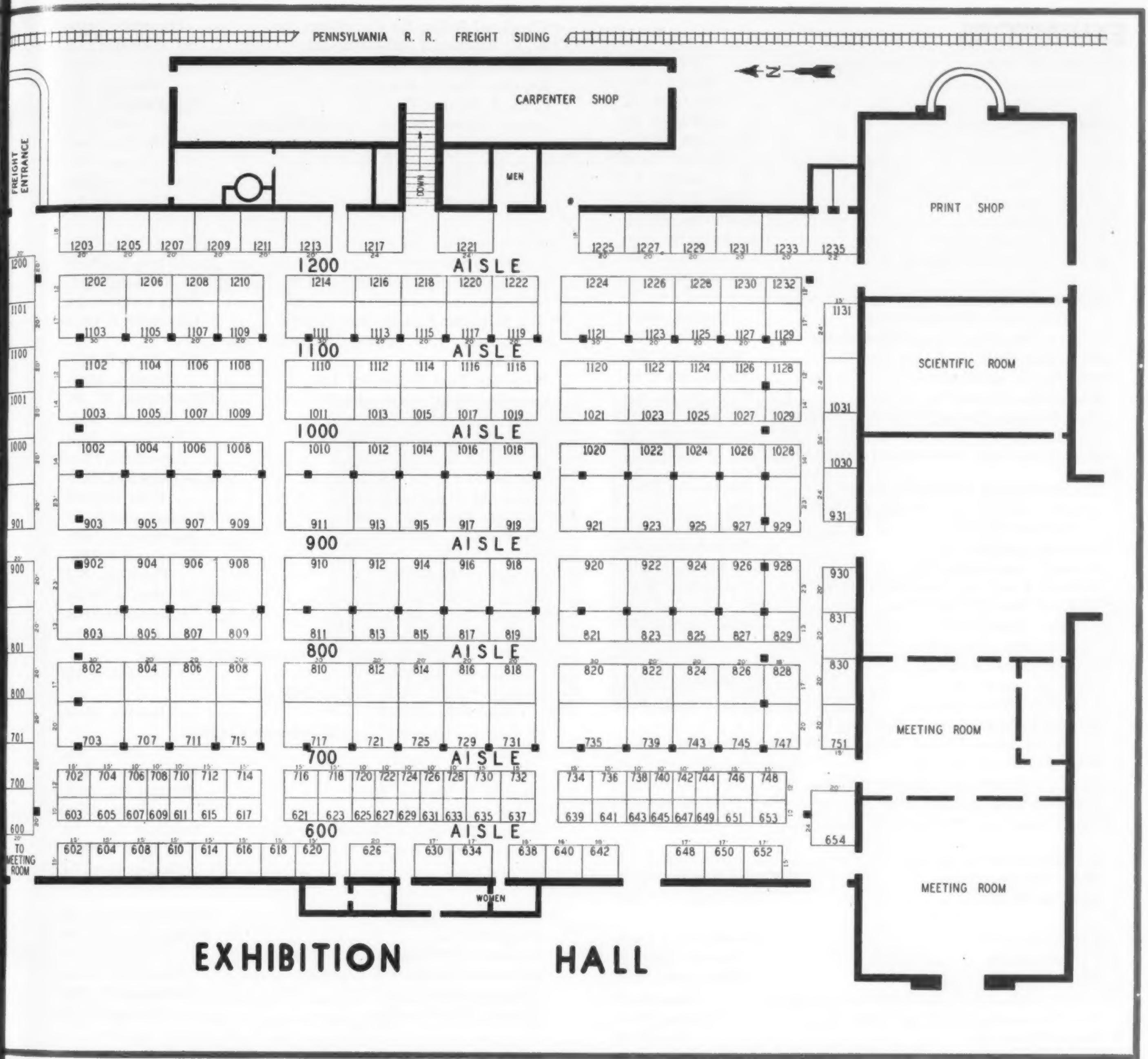


FOUNDRY EXHIBIT FLOOR

EXHIBITORS

(Continued)

*Harbison-Walker Refractories Co.	Pittsburgh, Pa.
Benj. Harris & Co.	Chicago Heights, Ill.
Harnischfeger Corp.	Milwaukee, Wis.
**Harrison Abrasive Corp.	Elizabeth, N.J.
Hercules Powder Co.	Wilmington, Del.
Herman Pneumatic Machine Co.	Pittsburgh 22, Pa.
Hickman, Williams & Co., Inc.	Philadelphia, Pa.
The Hill & Griffith Co.	Cincinnati, Ohio
The Hines Flask Co.	Cleveland, Ohio
The Frank G. Hough Co.	Libertyville, Ill.
Hougland & Hardy—Hardy Sand Co.	Evansville, Ind.
E. F. Houghton & Co.	Philadelphia, Pa.
Hydro-Blast Corp.	Chicago, Ill.
**Hyster Co.	Portland, Oregon
Illinois Testing Laboratories, Inc.	Chicago, Ill.
Independent Pneumatic Tool Co.	Chicago, Ill.
Induction Heating Corp.	Brooklyn 11, N.Y.
International Molding Machine Co.	LaGrange Pk., Ill.
Ingersoll-Rand Co.	New York, N.Y.
International Graphite & Electrode Corp.	St. Mary's, Pa.
*Industrial Fabricating, Inc.	Eaton Rapids, Mich.
International Nickel Co., Inc.	New York 5, N.Y.



PLAN 1948 AFA CONGRESS

EXHIBITORS

(Continued)

*Invincible Vacuum Cleaner Mfg. Co. .... Philadelphia, Pa.
The Iron Age .... New York 17, N.Y.
**The Ironton Fire Brick Co. .... Ironton, Ohio
The Jeffrey Mfg. Co. .... Columbus 16, Ohio
Johnson-March Corp. .... Philadelphia, Pa.
The Johnston & Jennings Co. .... Cleveland, Ohio

The Kindt-Collins Co. .... Cleveland, Ohio
**Andrew King, Cons. Engr. .... Narberth, Pa.
Lester B. Knight & Associates, Inc. .... Chicago, Ill.
H. Kramer & Co. .... Chicago, Ill.

Lauhoff Grain Co. .... Danville, Ill.
Lava Crucible Co. of Pittsburgh .... Pittsburgh 22, Pa.
R. Lavin & Sons, Inc. .... Chicago, Ill.
*Lindberg Engineering Co. .... Chicago, Ill.
**Linde Air Products Co. (Union Carbide & Carbon Corp.) .... New York, N.Y.
Link-Belt Co. .... Chicago, Ill.

The Macleod Co. .... Cincinnati, Ohio

(Continued On Next Page)

EXHIBITORS *(Continued)*

Manhatton Rubber Div. (Raybestos-Manhatton, Inc.) . . . Passaic, N.J.
Manly Sand Co. . . . Rockton, Ill.
Martin Engineering Co. . . . Kewanee, Ill.
Martindale Electric Co. . . . Cleveland 7, Ohio
**Master Pneumatic Tool Co. Inc. . . . Orwell, Ohio
Material Movements Industries, Inc. . . . Skokie, Ill.
Mathews Conveyors Co. . . . Ellwood City, Pa.
J. S. McCormick Co. . . . Pittsburgh 22, Pa.
Meehanite Metal Corp. . . . New Rochelle, N.Y.
Metallizing Co. of America . . . Chicago 4, Ill.
*Metlab Co. . . . Philadelphia, Pa.
Michigan Smelting & Refining Division, Bohn Aluminum and Brass Corp. . . . Detroit, Mich.
Millwood Sand Co., Ayers Mineral Co. . . . Zanesville, Ohio
Milwaukee Foundry Equipment Co. . . . Milwaukee, Wis.
Mine Safety Appliances Co. . . . Pittsburgh 8, Pa.
Modern Equipment Co. . . . Port Washington, Wis.
The Moulders' Friend (Purity Molding Sand Co.) . . . Dallas City, Ill.
*Murrell Dobbins Vocational-Technical School . . . Philadelphia

Nassau Smelting & Refining Co., Inc. . . . Tottenville, N.Y.
National Carbon Co. (Union Carbide & Carbon Corp.) . . . New York, N.Y.
*National Crucible Co. . . . Philadelphia, Pa.
National Engineering Co. . . . Chicago 6, Ill.
National Founders' Association . . . Chicago 3, Ill.
**National Foundry Sand Co. . . . Detroit 2, Michigan
*National Pigment Co. . . . Philadelphia, Pa.
**National Pulverizing Co. . . . Millville, N.J.
*National Safety Council . . . Chicago, Ill.
Newaygo Engineering Co. . . . Newaygo, Mich.
New Jersey Silica Sand Co. . . . Millville, N.J.
Niagara Falls Smelting & Refining Div. (Continental-United Industries Co., Inc.) . . Buffalo 17, N.Y.
Wm. H. Nicholls Co., Inc. . . . Richmond Hill 18, N.Y.
Nichols Engineering & Research Corp. . . . New York 5, N.Y.
Non-Ferrous Founders' Society . . . Chicago, Ill.
North American Smelting Co. . . . Philadelphia 34, Pa.

The S. Obermayer Co. (Ramtite Co.) . . . Chicago 8, Ill.
Oliver Machinery Co. . . . Grand Rapids, Mich.
The Osborn Mfg. Co. . . . Cleveland 14, Ohio

P M S Company . . . Cleveland 14, Ohio
**Palmer Bee Co. . . . Detroit 12, Mich.
Pangborn Corp. . . . Hagerstown, Md.
*Ottes E. Paris, Foundry Industrial Engineer . . . Chicago, Ill
The Peninsular Grinding Wheel Co. . . . Detroit, Mich.
**Penn-Rillton Co. . . . New York
**Pennsylvania Foundry Supply & Sand Co. . . . Philadelphia, Pa.
Penola, Inc. . . . Chicago, Ill.
George F. Pettinos, Inc. . . . Philadelphia 7, Pa.
*George Pfaff Inc. . . . Long Island City, N.Y.

Pittsburgh Crushed Steel Co. . . . Pittsburgh 1, Pa.
Pittsburgh Lectromelt Furnace Corp. . . . Pittsburgh, Pa.
Pittsburgh Metals Purifying Corp. . . . Pittsburgh 12, Pa.
*Plastic Corp. of Chicago . . . Cicero, Ill.
Powermatic Ventilator Co. . . . Cleveland 3, Ohio
Pratt & Whitney, Div. Niles-Bement-Pond Co. . . . West Hartford 1, Conn.
**Precision Grinding Wheel Co. . . . Philadelphia, Pa.
*Pressure Match Plate Co., Inc. . . . Philadelphia 23, Pa.
**Pulmosan Safety Equipment Corp. . . . Brooklyn, N.Y.
The Pyro Refractories Co. . . . Oak Hill, Ohio
The Pyrometer Instrument Co. . . . New York 13, N.Y.

**Quigley Co., Inc. . . . New York 17, N.Y.

Radium Chemical Co., Inc. . . . New York 22, N.Y.
The Ramtite Co. (S. Obermayer Co.) . . . Chicago 8, Ill.
Randall Foundry Equipment Corp. . . . Cleveland, O.
N. Ransohoff, Inc. . . . Cincinnati, Ohio
Ready-Power Co. . . . Detroit 8, Mich.
Redford Iron & Equipment Co. . . . Detroit 19, Mich.
*The Reed Roller Bit Co. (Cleco Div.) . . . Houston, Texas
*W. G. Reichert Engineering Co. . . . Newark, N.J.
Reliable Castings Corp. . . . Cincinnati 23, Ohio
Republic Coal & Coke Co. . . . Chicago, Ill.
H. H. Robertson Co. . . . Pittsburgh 22, Pa.
Robins Conveyors Div., Hewitt-Robins Inc. . . . Passaic, N.J.
**Roots-Connersville Blower Corp. . . . Connersville, Ind.
**Ross-Tacony Crucible Co. . . . Tacony, Pa.
The Rotor Tool Co. . . . Cleveland 12, Ohio
* Royer Foundry & Machine Co. . . . Kingston, Pa.

Safety Clothing & Equipment Co. . . . Cleveland 3, Ohio
Claude B. Schneible Co. . . . Detroit 16, Mich.
**A. Schrader's Son Div., Scovill Mfg. Co. . . . Brooklyn, N.Y.
Schramm, Inc. . . . West Chester, Pa.
**The Scientific Cast Products Corp. . . . Cleveland 3, Ohio
Semet-Solvay Div. (Allied Chemical & Dye Corp.) . . . New York 6, N.Y.
Severance Tool Industries, Inc. . . . Saginaw, Mich.
Simonds Abrasive Co. . . . Philadelphia 37, Pa.
Simplicity Engineering Co. . . . Durand, Mich.
W. W. Sly Manufacturing Co. . . . Cleveland, Ohio
Werner G. Smith Co. . . . Cleveland, Ohio
The Smith Facing & Supply Co. . . . Cleveland 13, Ohio
Smith Oil & Refining Co. . . . Rockford, Ill.
*Southern Ferro Alloys Div. . . . Chattanooga, Tenn.
The Spencer Turbine Co. . . . Hartford 6, Conn.
SPO Inc. . . . Cleveland 5, Ohio
Springfield Facing Co. . . . Harrison, N.J.
Standard Conveyor Co. . . . North St. Paul 9, Minn.
*Standard Electrical Tool Co. . . . Cincinnati, Ohio
Standard Horse Nail Corp. . . . New Brighton, Pa.
Standard Sand & Machine Co., Blystone Div. National Engineering Co. . . . Chicago 6, Ill.
Steel Shot & Grit Co. (Pitts. Crushed Steel Co.) . . . Boston, Mass.
Steel Shot Producers, Inc., Pittsburgh Crushed Steel Co. . . . Butler, Pa.
Sterling Wheelbarrow Co. . . . Milwaukee 14, Wis.
Frederic B. Stevens, Inc. . . . Detroit 26, Mich.
*Stoller Chemical Co. . . . Akron, Ohio
Stroman Furnace & Engineering Co. . . . Franklin Park, Ill.
Swan-Finch Oil Corp. . . . New York 20, N.Y.
Syntron Co. . . . Homer City, Pa.

The Tabor Mfg. Co. . . . Philadelphia 35, Pa.
Taggart & Co. . . . Philadelphia 35, Pa.
Tamms Silica Company . . . Chicago 1, Ill.
*Tennessee Products & Chemical Corp. . . . Nashville, Tenn.
Thiem Products, Inc. . . . Milwaukee 4, Wis.
*Tincher Products Co. . . . Chicago 7, Ill.

Union Carbide & Carbon Corp. . . . New York 17, New York
**United Compound Co., Inc. . . . Buffalo 4, N.Y.
United Oil Mfg. Co. . . . Erie, Pa.
United States Graphite Co. . . . Saginaw, Mich.
United States Hoffman Machinery Corp. . . . New York 3, N.Y.
*U.S. Navy . . . Washington, D.C
U. S. Reduction Co. . . . East Chicago, Ind.
*U. S. Rubber Co., Mechanical Goods Div. . . . New York, N.Y.

Vanadium Corporation of America . . . New York 17, N.Y.
Velsicol Corp. . . . Chicago, Ill.
Vesuvius Crucible Co. . . . Pittsburgh 18, Pa.

**Jervis B. Webb Co. . . . Detroit 4, Mich.
*The Wellman Products Co. . . . Cleveland, Ohio
**White Bros. Smelting Corp. . . . Philadelphia 37, Pa.
Whitehead Brothers Co. . . . New York 1, N.Y.
Whiting Corp. . . . Harvey, Ill.
Wilson Industries, Inc. . . . Boston, Mass.

The Yale & Towne Mfg. Co. . . . Philadelphia 24, Pa.
Young Bros. Co. . . . Detroit, Mich.

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*Have never Exhibited
**Did not Exhibit in 1946

OFFICERS AND DIRECTORS

PRESIDENT

Max Kuniansky
Vice President and
General Manager
Lynchburg Foundry Co.
Lynchburg, Virginia

VICE-PRESIDENT

W. B. Wallis
President
Pittsburgh Lectromelt
Furnace Corporation
Pittsburgh, Pa.

DIRECTORS

(Terms expire 1948)

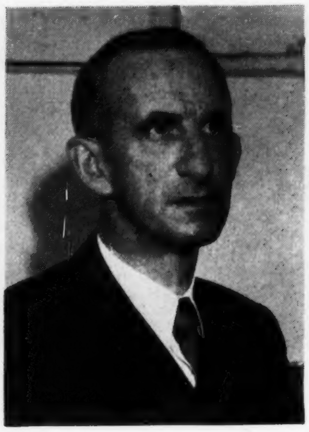
Robt. R. Gregg, Foundry Superintendent, Reliance Regulator Corp., Alhambra, Calif.
E. W. Horlebein, President, Gibson & Kirk Co., Baltimore, Md.
Harold H. Judson, Foundry Manager, Minneapolis-Moline Power Implement Co., Minneapolis, Minn.
Jas. H. Smith, General Manager, Central Foundry Div., General Motors Corp., Saginaw, Mich.
F. M. Wittlinger, Secretary-Treasurer, Texas Electric Steel Casting Co., Houston, Texas.
S. V. Wood, President and Manager, Minneapolis Electric Steel Castings Co., Minneapolis, Minn.

(Terms expire 1949)

H. G. Lamker, Superintendent of Foundries, Wright Aeronautical Corp., Wood Ridge, N.J.
B. L. Simpson, President, National Engineering Co., Chicago.
H. A. Deane, Vice President of Operations, American Brake Shoe & Castings Division, American Brake Shoe Co., New York, N.Y.
S. C. Wasson, Manager, National Malleable & Steel Castings Co., Chicago.
J. E. Kolb, Pattern Shop Superintendent, Caterpillar Tractor Co., Peoria, Ill.

(Terms expire 1950)

E. N. Delahunt, General Superintendent, Warden King, Ltd., Montreal, Quebec, Canada.
W. J. MacNeill, General Manager, G. H. R. Division, Dayton Malleable Iron Co., Dayton, Ohio.
J. M. Robb, Jr., Resident Manager, Hickman Williams & Co., Philadelphia, Pa.
A. C. Ziebell, President and Treasurer, Universal Foundry Co., Oshkosh, Wis.
R. H. McCarroll, Chief Metallurgist, Ford Motor Co., Dearborn, Mich.



H. G. Lamker

H. A. Deane

A. C. Ziebell

W. J. MacNeill

E. N. Delahunt

DIRECTORS OF THE AMERICAN F

RETIRING DIRECTORS

Jas. H. Smith

F. M. Wittlinger

E. W. Horlebein

S. C. Wasson

J. E. Kolb

J. M. Robb, Jr.

B. L. Simpson

R. H. McCarroll
Died March 31, 1948

N FOUNDRYMEN'S ASSOCIATION

RETIRING DIRECTORS

Robt. R. Gregg

H. H. Judson

S. V. Wood

Awards

For Outstanding Service . . .

MAX KUNIANSKY

TO MAX KUNIANSKY
Honorary Life Membership

"in recognition of leadership as president of the American Foundrymen's Association, 1947–1948."

TO EGBERT H. BALLARD
The Wm. H. McFadden Gold Medal

"for steadfast and sincere efforts in behalf of the Association while serving as its president."

E. H. BALLARD

R. G. MCELWEE

TO PETER E. RENTSCHLER
The Peter L. Simpson Memorial Medal

"for outstanding work in promoting better housekeeping and safety practices in the foundry. . ."

TO R. G. MCELWEE
The John A. Penton Gold Medal

"for outstanding contributions to the dissemination of information to the foundry industry."

P. E. RENTSCHLER

ASSOCIATION TO HONOR FOUR MEMBERS

American Foundrymen's Association will confer gold medals in recognition of personal contributions to the advancement of the castings industry upon three outstanding foundrymen, and honorary life membership upon its retiring national president at the Annual Banquet of the 1948 Foundry Congress and Show at the Bellevue-Stratford Hotel, Philadelphia.

Egbert H. Ballard, the eleventh recipient of the William H. McFadden Gold Medal, founded in 1923, has been voted the award in recognition of his *"steadfast and sincere efforts in behalf of the Association while serving as its president during most difficult times, and his continual contributions to the Foundry Industry throughout his business career."*

Presentation will be made by A.F.A. Past President James L. Wick, Jr., president and treasurer of Falcon Bronze Co., Youngstown, Ohio.

Mr. Ballard was head of A.F.A. in 1931-32, Vice-President the preceding year, and National Director from 1927 to 1930. Active in other foundry groups, as well as in various national technical committees of A.F.A., he served as president of the New England Foundrymen's Association in 1922.

A native of Hartford, Conn., he received his early education in Lynn, Mass., where his father was associated with Thomson-Houston Electric Co. As a schoolboy, he spent his summer vacations working in various departments of the plant, and in 1894 he took a position as a clerk in the steel foundry. Mr. Ballard remained with the firm until 1905, and acquired a background in all phases of foundry operations.

In 1905 he was appointed superintendent of the Massachusetts Steel Casting Co., Everett. The firm was later purchased by General Electric Co., with which organization Mr. Ballard was then affiliated until his retirement in 1943. He was later given charge of the Lynn steel foundry and the brass foundry; and was appointed general superintendent of all foundries and pattern shops in 1925.

R. G. McElwee will receive the John A. Penton Gold Medal for *"outstanding contributions to the dissemination of information to the foundry industry, especially for his splendid efforts on behalf of the Cupola Research Project."*

Fred J. Walls, manager of the Detroit section, International Nickel Co., and Past President of A.F.A. will make the fourteenth conferral medal.

For the past several years, Mr. McElwee has presented 15 to 20 talks per year on gray iron foundry practice to A.F.A. chapters and has also addressed chapters and conferences of other scientific groups on iron foundry procedures and engineering properties and applications of iron.

He is the present chairman of the A.F.A. Gray Iron Division, has been chairman of the Cupola Research Committee since 1943, and has also been active in several other national technical committees of the Association. Mr. McElwee is the author of a number of papers on inoculation of iron, and of a widely quoted work on carbon-silicon section-size relationship.

In addition to A.F.A., he holds membership in the American Society for Metals, American Society for Testing Materials, Society of Automotive Engineers, and the Engineering Society of Detroit.

Identified with the foundry field for more than 30 years, Mr. McElwee began his career with Muncie (Ind.) Foundry & Machine Co. as chief inspector. His industrial background includes association with General Motors Truck Co., Pontiac, Mich.; American Car & Foundry Co., Detroit; Whitehead & Kales Co., River Rouge, and Ecorse (Mich.) Foundry Co. He is a native of Williamsport, Pa., and received his education in public schools there and in Galeton, Pa.

Peter E. Rentschler will receive the Peter L. Simpson Memorial Medal for his *"outstanding work in promoting better housekeeping and safety practices in the foundry and for the inspiration he has given the foundry industry in the field of public relations."* He will be the third recipient of the award, founded in 1946.

Presentation of the medal will be by Walter L. Seelbach, president, Superior Foundry, Inc., Cleveland, Ohio, and a former A.F.A. National Director.

Mr. Rentschler is a native of Hamilton, Ohio, and a graduate of Princeton University. He joined Hamilton Foundry & Machine Co. in 1920 and was named a director that year. In 1923 he was named vice-president; and in 1927, president.

He also serves as secretary of the Decatur Casting Co., Hamilton and Decatur, Ind., and as chairman of the board, Citizens Bank & Trust Co., and president of Citizens Realty Co., both of Hamilton. Active in many civic and fraternal groups, Mr. Rentschler has served as vice-president of the Hamilton Chamber of Commerce; president of the Hamilton Safety Council; a trustee of the Hospital Care Corp., Cincinnati; member of the Ohio Citizens School Committee, and member of the Hamilton City Board of Education, of which he has been president since 1944.

In addition to his A.F.A. affiliation, Mr. Rentschler holds membership in the American Society for Metals, Engineering Society of Cincinnati, and Society for the Advancement of Management. A founding trustee of the Foundry Educational Foundation, he was named its vice-president last year.

Max Kuniansky, who will be honored as retiring head of the Association, will receive a certificate of honorary life membership in recognition of his leadership during the past year. Immediate Past President S. V. Wood, president and general manager, Minneapolis Electric Steel Castings Co., Minneapolis, Minn., will make the presentation.

Mr. Kuniansky served as a Director of A.F.A. from 1943 to 1946, and as Vice-President for 1946-47. Internationally recognized as an authority on the metallurgy of gray iron, he was the 1941 recipient of the William H. McFadden Gold Medal for his contributions to the technology of the castings field and his cooperative work in A.F.A. technical committees.

He was born in Russia, came to this country at an early age, and earned his degree of bachelor of science in chemical engineering at the Georgia School of Technology, Atlanta. He joined Lynchburg Foundry Co. as chief chemist in 1923 and was appointed vice-president and general manager in 1943.

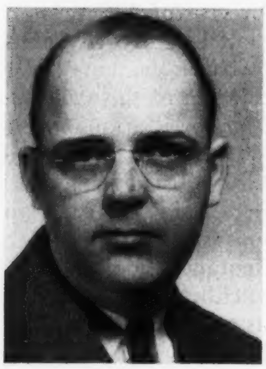
ANNUAL LECTURE COURSE COVERS QUALITY CONTROL PROCEDURES

WILLIAM ROMANOFF
Vice-President
H. Kramer & Co.
Chicago

F. J. WALLS
Manager
Detroit Section
International Nickel Co.

M. O. BOOTH, *Manager*
Saginaw Malleable Plant
General Motors Corp.
Saginaw, Mich.

J. W. JUPPENLATZ
Chief Metallurgist
Lebanon Steel Foundry
Lebanon, Pa.



E. V. BLACKMUN
Chief Works Metallurgist
Aluminum Co. of America
Cleveland

TIMELY DATA ON QUALITY CONTROL test procedures an aspect of foundry technology that has grown in importance with the developments of modern engineering and is vital to successful foundry practice today, will be available to those attending the 52nd Annual A.F.A. Convention through the five special lectures offered by the Annual Lecture Committee.

This year's course will cover quality control practices for aluminum and magnesium; brass, bronze and nickel alloys; gray iron; malleable iron; and steel; and will be of interest to technologists in the foundry industry, in view of the demand for quality castings under conditions of material shortages and substitutions.

Sessions will be at 4:00 p.m. Monday through Thursday. Subjects will correspond with the divisional interest of the days on which they are scheduled.

Aluminum and magnesium will be the topic Monday; brass, bronze and nickel, and malleable iron, the topics of simultaneous meetings Tuesday, in which the programs of the light metals, brass-bronze and malleable groups are concentrated. Gray iron and steel meetings of the Convention will be held Thursday and Friday, with the related lectures presented Wednesday and Thursday, respectively.

Thus, Division members will be able to plan for attendance at this important series during the time they will be in Philadelphia for the programs of their specific interest groups. Most of those interested in gray iron will probably arrive in time for the Annual Business Meeting, Wednesday morning, and will then have the afternoon free for the quality control lecture.

Lecturers for the course, all widely-recognized as outstanding technologists of the castings industry, are E. V. Blackmun, chief works metallurgist, Aluminum Co. of America, Cleveland; M. O. Booth, manager of the Saginaw (Mich.) Malleable plant of General Motors Corp.; J. W. Juppenlatz, chief metallurgist, Lebanon (Pa.) Steel Foundry; William Romanoff, vice-president, H. Kramer & Co., Chicago; F. J. Walls, manager, Detroit section, International Nickel Co.

History of the Lecture Committee series extends back to 1939, when "The Microscope in Elementary Cast Iron Metallurgy," was presented. The following year demonstratitons on crystallization were featured.

These first courses were enthusiastically received, and the interest of the members led the committee to continue the series and to broaden the coverage of important phases of the science of metals casting. In 1941 and 1942, a comprehensive, two-year course on "Modern Core Practices and Theories" was offered which led to the A.F.A. book by that title. "Theory and Practice of Gating and Risering" was the topic in 1943; "Heading and Gating," in 1944. At the "Golden Jubilee" Congress and Show of 1946, the committee presented a course on "Foundry Control."

Although no course was offered in 1947, the preparation for this year's series was already in progress. The subject was selected, as has been the case since the series was launched, as one in which there is a wide-spread interest in the field, and concerning which there is a need for up-to-the-minute data.

PHILADELPHIA CHAPTER

Chairman	*Vice-Chairman*	*Secretary-Treasurer*
E. C. Troy National Engineering Co.	C. L. Lane Florence Pipe Foundry & Machine Co. Florence, N.J.	W. B. Coleman W. B. Coleman Co.

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General Steel Castings Corp.

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B. A. Miller
Cramp Brass & Iron Foundries Div.
Baldwin Locomotive Works

William Morley
Olney Foundry Division
Link-Belt Co.

W. B. Wilkins
American Manganese Bronze Co.

HOSTS TO THE 1948 A.F.A. FOUNDRY CONGRESS

E. C. Troy
Service and Sales Engineer
National Engineering Co.

General Chairman
Convention Committee
Philadelphia Chapter

C. L. Lane

GENERAL COMMITTEE ON ARRANGEMENTS

Chairman: John M. Robb, Jr., Hickman, Williams & Co., Philadelphia.
Co-Chairman: W. B. Morley, Olney Foundry Div., Link-Belt Co., Philadelphia.
Secretary-Treasurer: R. J. Keeley, Ajax Metal Co., Philadelphia.
B. A. Miller, Cramp Brass & Iron Foundries Div., Baldwin Locomotive Works, Philadelphia.
W. B. Wilkins, American Manganese Bronze Co., Philadelphia.
S. C. Kirn, M. L. Kirn & Bros., Philadelphia.
H. L. McClees, Crucible Steel Casting Co., Lansdowne.
H. P. Good, Textile Machine Works, Reading, Pa.
George F. Pettinos, Jr., George F. Pettinos, Inc., Philadelphia.
T. J. Gerwig, Republic Steel Corp., Philadelphia.

W. B. Coleman

LADIES' ENTERTAINMENT COMMITTEE

Chairman: H. J. Williams, New Jersey Silica Sand Co., Millville, N.J.

Co-Chairman: Mrs. H. J. Williams.

Mrs. C. W. Mooney, Jr.
Mrs. M. B. Valentine
Miss Irene Gocher
Mrs. W. D. Bryden
Miss Dorothea M. Thum
Mrs. C. W. Thompson
Mrs. E. C. Benkert
Mrs. K. S. Matz

RECEPTION COMMITTEE

Chairman: H. E. Mandel, Pennsylvania Foundry Supply & Sand Co., Philadelphia.

Co-Chairman: A. A. Thum, Palmyra Foundry Co., Palmyra, N.J.

F. L. Mattson, Hickman, Williams & Co., Philadelphia.
J. P. Hoot, Carson, Marshall Co., Inc., Philadelphia.
A. H. Scherer, Acme Brass & Bronze Foundry, Inc., Philadelphia.
G. H. Bradshaw, Philadelphia Navy Yard, Philadelphia.
J. E. Finnegan, Colonial Smelting & Refining Co., Columbia, Pa.
M. Calciano, Chas. Mousley's Sons, Philadelphia.
Wm. M. Davies, Reading Foundry & Supply Co., Reading, Pa.
H. Lloyd Hess, Lancaster Malleable Castings Co., Lancaster, Pa.
C. H. Meminger, Lancaster Iron Works, Inc., Lancaster, Pa.
Werner Finster, American Chain & Cable Co., Inc., Reading, Pa.
H. D. Horton, Ingersoll-Rand Co., Phillipsburg, N.J.
Robert Latham, Bethlehem Steel Co., Bethlehem, Pa.
N. H. Oliver, Downington Mfg. Co., Downington, Pa.
John Juppenlatz, Lebanon Steel Foundry, Lebanon, Pa.
S. G. Flagg, III, Stanley G. Flagg & Co., Philadelphia.
J. W. March, Camden Foundry Co., Camden, N.J.
P. B. Harner, Union Mfg. Co., Inc., Boyertown, Pa.
W. E. Jones, National Engineering Co., Drexel Hill, Pa.
C. B. Somers, Whitehead Bros. Co., New York.
J. W. Mentzer, Taggart & Co., Philadelphia.
H. D. Ritter, Sanitary Co. of America, Linfield, Pa.
J. N. Lanning, Perseverance Iron Foundry, Inc., Philadelphia.
C. D. Hamburg, Bonair Foundry Co., Philadelphia.
E. C. Benkert, Fairmont Foundry, Inc., Philadelphia.
R. E. Teach, Werner G. Smith Co., Haverford, Pa.

A. A. Thum

Mrs. H. J. Williams

B. A. Miller

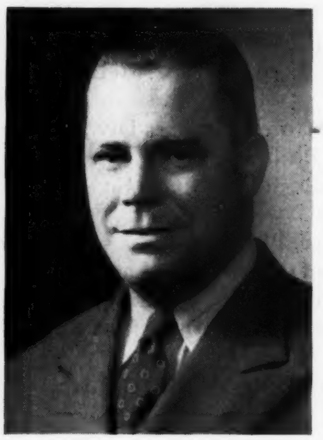
W. B. Wilkins

G. F. Pettinos, Jr.

H. E. Mandel

Mrs. C. W. Thompson

S. J. Kirn



C. B. Jenni

Louis Dill

C. W. Mooney, Jr.

Mrs. K. S. Matz

H. J. Williams

Edward Berry

Arnold Kraft

A. C. Gocher

Miss Dorothea Thum

Earl Eastburn

H. E. Mandel, Pennsylvania Foundry Supply & Sand Co., Philadelphia.

Paul Brooks, Debevoise Anderson Co., Inc., Philadelphia.

L. E. Bilger, Keystone Grey Iron Foundry Co., Pottstown, Pa.

J. A. Keeth, Penn Steel Castings Co., Chester, Pa.

G. G. Bewley, Bethlehem Steel Co., Philadelphia.

H. N. Albright, Columbia Malleable Castings Corp., Columbia, Pa.

D. G. Burkert, Eastern Foundry Co., Boyertown, Pa.

G. L. Coppage, Pusey & Jones Corp., Wilmington, Del.

T. A. Walker, Jr., Warren Foundry & Pipe Corp., Phillipsburg, N.J.

M. G. Moore, Jr., Empire Steel Castings, Inc., Reading.

R. S. Munson, Atlantic Steel Castings Co., Chester, Pa.

K. S. Matz, North Bros. Mfg. Co., Philadelphia.

PLANT VISITATION COMMITTEE

Chairman: C. W. Mooney, Jr., Olney Foundry Div., Link-Belt Co., Philadelphia.

Co-Chairman: Edward Berry, Dodge Steel Co., Philadelphia.

H. J. Johnston, General Steel Castings Corp., Eddystone, Pa.

W. A. Brown, Florence Pipe Foundry & Machine Co., Florence, N.J.

H. W. Stuart, United States Pipe & Foundry Co., Burlington, N.J.

G. H. Bradshaw, Philadelphia Navy Yard, Philadelphia.

J. S. Csaklos, Crucible Steel Castings Co., Lansdowne.

W. D. Bryden, Philadelphia Bronze & Brass Corp., Philadelphia.

R. E. Schmidt, Rolle Casting Co., Inc., Philadelphia.

R. M. Carrigan, North American Smelting Co., Philadelphia.

EDUCATIONAL EXHIBITS COMMITTEE

Chairman: A. C. Gocher, Fletcher Works, Inc., Philadelphia.

R. M. Brick, University of Pennsylvania, Philadelphia.

John J. L. Gross, Murrell Dobbins Vocational-Technical School, Philadelphia.

A. W. Grosvenor, Drexel Institute of Technology, Philadelphia.

D. J. Jones, New Jersey Silica Sand Co., Millville, N.J.

C. L. Lane, Florence Pipe Foundry & Machine Co., Florence, N.J.

C. W. Mooney, Jr., Olney Foundry Div., Link-Belt Co., Philadelphia.

Edward Saks, Murrell Dobbins Vocational-Technical School, Philadelphia.

J. J. Thompson, Fletcher Works, Inc., Philadelphia.

J. B. Vernon, Dodge Steel Co., Philadelphia.

S. B. Wentz, Pennsylvania Foundry Supply & Sand Co., Philadelphia.

H. J. Williams, New Jersey Silica Sand Co., Millville.

SHOP COURSE COMMITTEE

Chairman: W. B. Morley, Olney Foundry Div., Link-Belt Co., Philadelphia.

Co-Chairman: Arnold Kraft, Wilkening Mfg. Co., Philadelphia.

S. C. Kirn, M. L. Kirn & Bros., Philadelphia.

Edwin A. Zeeb, Dodge Steel Co., Philadelphia.

Last Call for Written Questions To Be Answered at Quiz Sessions

DIRECT ADVICE ON INDIVIDUAL PROBLEMS will be offered delegates to the 1948 Foundry Congress at four Convention sessions featuring the popular question-and-answer type of program.

A.F.A. committeemen have organized a round of pass-the-information meetings, to promote the free exchange of ideas and information through which those present may obtain practical recommendations suited to their own operational difficulties. "Quiz" programs, in which the audience directs the discussion through questions and comments, bring the attention of panels of authoritative speakers to bear on aspects of the subject which are of the most immediate value to the group.

Delegates to the A.F.A. Convention and Show, May 3-7, will find this year's quizzes an ideal complement to the balance of a technical program featuring outstanding formal papers, lecture courses, round tables, symposia and committee reports.

A six-man panel will begin the round of question-and-answer meetings at the 10:00 a.m. Monday session of the Educational Division. *Recruiting and Training of Foundry Personnel* is the topic.

Professor W. H. Ruten of Polytechnic Institute of Brooklyn will serve as chairman, and L. G. Probst of National Engineering Co., Chicago, as co-chairman.

Speakers are Professor G. J. Barker, University of Wisconsin, Madison; I. Ivan, apprentice supervisor for Whiting Corp., Harvey, Ill.; Glen Kies, Industrial Training Service, Detroit; H. L. Rosse, Eddystone (Pa.) Borough Schools; F. B. Skeates, superintendent of foundries, Link-Belt Co., Chicago; Professor R. S. Tour, University of Cincinnati.

The Refractories Committee will conduct another of its "Information Please" sessions, which have proven highly successful at past Conventions, Wednesday evening at 8:00 p.m. A. S. Klopf, Western Foundry Co., Chicago, will preside. Co-chairman will be C. F. Joseph, Central Foundry Div., General Motors Corp., Saginaw, Mich.

Thursday afternoon, 2:00 p.m., the Foundry Cost Committee will handle queries on cost accounting methods, distribution of costs and application of cost data. Presiding officer will be the Foundry Cost Committee Chairman R. L. Lee, Grede Foundries, Inc., Milwaukee, and co-chairman, C. E. Westover, Westover Engineers, Milwaukee.

Completing the series, the Job Evaluation and Time Study Committee offers to take up any problems within the scope of the committee's work, Thursday afternoon at 4:00.

Chairman will be R. J. Fisher, Falk Corp., Milwaukee, head of the committee; co-chairman, M. E. Annich, American Brake Shoe Co., Mahwah, N.J.

At all these sessions, speakers will answer questions submitted in advance, in writing, and those raised from the floor during discussion. Delegates who have specific problems they would like to have analyzed and discussed may write them up and send them, in advance of Convention week, to:

Educational—Professor W. H. Ruten, chairman, industrial processes department, Polytechnic Institute of Brooklyn, Brooklyn, N.Y.

Refractories—R. H. Stone, sales manager, Vesuvius Crucible Co., 2216 Palmer St., Pittsburgh 18, Pa.

Costs—R. L. Lee, secretary-treasurer, Grede Foundries, Inc., 6432 W. State St., Milwaukee, Wis.

Job Evaluation—Time Study—R. J. Fisher, standards department, The Falk Corp., Milwaukee, Wis.

Student - Operated Foundry Feature Of Murrell Dobbins School Exhibit

ONE OF THE OUTSTANDING EXHIBITS at the 52nd A.F.A. Foundry Congress will be a foundry shop operated by students of the Murrell Dobbins Vocational-Technical school of Philadelphia. Sand testing, bench and floor molding, and non-ferrous casting will be featured in the exhibit, which will be operated under the supervision of John L. Gross, the school's coordinator of foundry practice, and Edward Saks, instructor.

J. N. Baker J. L. Gross

Established in 1938, Murrell Dobbin's original enrollment of 400 students has today reached more than 7000, with 220 instructors. Day and evening classes in dozens of commercial and industrial subjects, ranging from Beauty Culture to Plumbing, and including such technical courses as Foundry Practice, Sheet Metal Working, Welding, Machine Shop Practice, and Machine Design, are offered free to Philadelphians.

With the advent of the war, Murrell Dobbins maintained a 24-hour, seven-day-a-week schedule, training more than 65,000 Philadelphians to become skilled workers in vital war industries. Today, the school is training thousands of veterans in the industrial sciences.

Murrell Dobbins, through its principal, J. Norwood Baker, has issued an invitation to all A.F.A. members and guests attending the Foundry Congress to visit the school's foundry practice classes.

Both the regular day classes and the evening apprentice courses will be open to inspection. Here, students and apprentices are trained in the various operations of the craft, including bench and floor work, molding machine operation, and cupola and furnace practice. Basic courses instruct the students in the elements of molding, metal pouring, and casting finishing. Advanced students learn metal mixing, temperature control, blueprint reading, patternmaking, and foundry safety practices.

Currently, a series of lectures under the sponsorship of the Philadelphia Chapter Educational Committee is being conducted evenings and is open to all interested foundrymen and students.

TEXTBOOK AUTHORS SELECTED

MEETING A NEED FOR FOUNDRY TEXTBOOKS written for present-day educational and training programs, the A.F.A. Textbook Committee has completed arrangements for preparing two of three proposed texts. Authors for the college text and the high school text have been selected and have prepared book outlines for committee consideration. An author for the third book in the series, the trade text—covering vocational and apprentice training—will be selected in the future.

The college text will emphasize fundamentals and basic laws involved in founding with secondary consideration being given to mechanics of operation. Stress will be laid on the "why" of foundry practice rather than on the "how." The book is expected to

P. E. Kyle

D. F. Barich

include material suitable for any undergraduate foundry college course and will treat foundry operations by fundamental processes. Laboratory experiments will not be included, but suggestions for appropriate experiments to demonstrate fundamentals will be given.

P. E. Kyle, professor of applied metallurgy, Cornell University, Ithaca, N.Y., will write the college foundry text. Active in three A.F.A. divisions, he has a background of teaching, industrial work, and consulting in the foundry industry, and in metal processing.

Professor Kyle, first to hold the Bard Professorship of Metallurgy established late last year, is a graduate of Cornell and holds an M.S. degree in mechanical engineering from Massachusetts Institute of Technology, Cambridge. From 1933 to 1934, he held the James Ward Packard Fellowship at Lehigh University, Bethlehem, Pa., and for the following 12 years was a member of the faculty at MIT, where his teaching included courses in materials and metals processing.

During the war, Professor Kyle served as a consultant on materials and production methods for the British Air Commission and as a research supervisor for the U. S. War Metallurgy Committee. In addition to the American Foundrymen's Association, he is active on committees of the American Society of Mechanical Engineers, the American Welding Society, the American Society for Testing Materials, and the American Society for Engineering Education.

The creative method of teaching is to be emphasized in the high school text. Detailed procedures for shop projects are planned for the book which is to be primarily descriptive and extensively illustrated. Typical types of foundry equipment are to be included, as well as a description of the three levels of talent required in the foundry industry and the variety of work involved.

Dewey F. Barich, professor and head of the industrial arts department, Kent State University, Kent, Ohio, will write the high school foundry text. Born in Hibbing, on one of the Minnesota iron ranges, he graduated from Stout Institute, Menomonie, Wis., in 1933 with a B.S. degree in industrial education.

Going to Michigan, Professor Barich taught industrial arts and metal trades in the public schools of Flint and Trenton, and received the degree M.A. in education from the University of Michigan, Ann Arbor. For a year, he taught industrial arts teacher education at Central College of Education, Mt. Pleasant. He had been supervisor of trade and industrial education two years for the Michigan State Board of Control for Vocational Education when he took his present position.

During the war, Professor Barich was an engineering officer with the U. S. Navy, and saw service in the South Pacific and Philippine theaters of operation.

Preliminary discussions by the Textbook Committee indicate that the trade text should place emphasis on "know how" and possibly include a manual integrated with the text. The manual alone, properly integrated with the college text may be sufficient since there is some indication that the latter would be used by a number of apprentice training instructors. The trade text is expected to be suitable for unit trade training, technical high schools, and trade extension courses.

Textbook authors are being guided by the Textbook Committee, under the chairmanship of Professor G. J. Barker, head of the mining and metallurgical department, University of Wisconsin, Madison, and an advisory group representing the A.F.A. divisions.

Ohio State Gets Molding Machines

Ohio State University, Columbus, has received three molding machines from Tabor Mfg. Co., Philadelphia, Pa., according to Dr. F. H. Lehoczky, chairman of the industrial engineering department. Valued at $4,500, the machines were presented to the university's development fund for installation in the foundry laboratory being developed under Dr. D .C. Williams.

The foundry industry has been most cooperative in aiding the development program according to Dr. Williams. An A.F.A. research fellow at Cornell University, Ithaca, N.Y., he joined the Ohio State faculty last fall. He is one of the faculty's advisors to the recently formed Ohio State Student Chapter of A.F.A.

Schedule Industrial Relations Meet

THE ELEVENTH ANNUAL STATE-WIDE CONFERENCE of the Industrial Relations Association of Wisconsin will be held at the Elk's Club, Milwaukee, May 1. Co-operating in the conference are the Wisconsin Chapter of A.F.A., the University of Wisconsin, Marquette University, Milwaukee Vocational School and many state, civic, and industrial organizations.

CONVENTION PLANT VISITATIONS

THE PHILADELPHIA NAVY YARD, foundries, and a technical school in the Philadelphia area extend an invitation to A.F.A. members and visitors at the 52nd Annual A.F.A. Foundry Congress to inspect their facilities and operations.

Located in Philadelphia and vicinity, and in the neighboring states of New Jersey and Delaware, these plants offer the opportunity to observe such operations as centrifugal casting of iron pipe, carbon and low-alloy steel casting, electric furnace melting, locomotive frame and turbine casting, and rotary furnace production of copper-base alloys. In addition, the Philadelphia Navy Yard will conduct tours through its foundry, aircraft factory, ships, drydocks, and shops.

Arrangements to visit the plants listed and described below have been made by the Plant Visitation Committee headed by C. W. Mooney, Jr., Link-Belt Co., Philadelphia. Visitors should register at the Plant Visitation Booth, A.F.A. Headquarters, Convention Hall.

*__Florence Pipe Foundry & Machine Co.,__ Florence, N.J.:
Produces sand-spun, centrifugally cast, iron pipe. Four inch to 10 in. diameter in 16-ft lengths; 12 in. to 30 in. diameter in 16-ft and 20-ft lengths. Daily capacity over 300 tons. Pipe fittings, hydrant and valve castings, hydraulic machinery castings, and general castings from two pounds to 25,000 lb. Company operates machine shop, pattern shop, and brass foundry.

*__United States Pipe & Foundry Co.,__ Burlington, N.J.:
Super deLavaud cast iron pipe centrifugally cast. Three inch to 24 in. diameter pipe cast in metal molds in 12-ft and 18-ft lengths. Daily capacity 450 tons. Also stainless steel tubing, piston rings, cast iron rolls, dual metal castings.

*Bus transportation to the above two plants available Tuesday, May 4, and Thursday, May 6, leaving Convention Hall about 10:00 a.m., and returning about 4:30 p.m. Luncheon at the plants arranged by the companies. Daily limit, 100 per trip, visiting one plant in the morning and the other in the afternoon.

Eastern Malleable Iron Co., Wilmington, Del.:
Makes malleable and pearlitic malleable iron castings, small and large; specialize in heavy duty truck castings such as rear axle housings. Air furnace melting, and radiant tube and electric furnace annealing. Carbon steel castings, converter operation, and machine shop.

Open May 5 and 6, beginning at 1:00 p.m. Take Pennsylvania R.R. to Wilmington where transportation is arranged from station to foundry.

Dodge Steel Co., Tacony, Philadelphia:
Jobbing steel foundry producing carbon and low alloy steel castings with an average weight of 20 lb. Melting done in acid electric furnaces.

Open May 3, 4, and 5, 9:00 a.m. to 11:00 a.m.; May 6, 2:00 p.m. to 4:00 p.m. A 12½ mile ride by subway, surface car, or taxi.

Crucible Steel Casting Co., Lansdowne, Pa.:
Jobbing foundry making electric furnace steel.

Open May 3 through 6 from 1:00 p.m. to 3:00 p.m. Can be reached by subway or taxi.

General Steel Castings Corp., Eddystone, Pa.:
Produce large steel castings for railroads and other industries, such as locomotive frames, car trucks, turbine castings, etc. Operate large machine shop.

Open May 5, 6, and 7 at 2:00 p.m. Groups limited to 75 each. Can be reached by suburban train to either Eddystone or Chester and from there by bus or taxi.

Philadelphia Navy Yard, Philadelphia:
Foundry produces all ferrous and non-ferrous castings except magnesium and malleable iron. The iron foundry has a capacity of 100 tons per day and can pour castings up to 35 tons. The steel foundry has a daily capacity of 25 tons and can make castings up to 16 tons. Castings up to 50 tons can be poured in the non-ferrous foundry which has a daily capacity of 82 tons.

Open May 5 only, 9:30 a.m. to 4:00 p.m. Can be reached by surface line, bus, or taxi. Conducted tours throughout the yard include the aircraft factory, ships, drydocks, and shops.

Philadelphia Bronze & Brass Corp., 22nd and Master St., Philadelphia:
Non-ferrous jobbing foundry producing castings from one ounce to 5,000 lb in nearly every non-ferrous alloy, including nickel and its alloys, pure copper, and age-hardening copper alloys.

Open May 3 through 7, 10:00 a.m. to 4:00 p.m. Can be reached by surface car or taxi. Visitors accommodated as they present themselves.

North American Smelting Co., Philadelphia:
Production of copper-base alloys in rotary furnaces. Latest type of equipment for handling hot metal and scrap.

Note that visitation will be to the Wilmington, Del., plant only, which will be open May 3 through 7. Transportation will be provided by private cars for groups of four or five.

Olney Foundry Division, Link-Belt Co., 180 W. Duncannon Ave., Philadelphia:
Produces gray iron, white iron, chilled iron, and high-alloy iron castings. Melting for this mechanized jobbing foundry for castings from a few ounces to 10 tons is done in cupolas.

Open May 4 through 7, 10:00 a.m. to 2:00 p.m. Can be reached by surface lines, bus, or taxi. Groups will be handled as they arrive.

Murrell Dobbins Vocational-Technical School, Philadelphia:
Visitors desiring to inspect this excellent school should inquire at the Plant Visitation Booth, A.F.A. Headquarters, Convention Hall.

R. H. McCarroll Dies

RUSSELL HUDSON MCCARROLL, director of chemical and metallurgical engineering and research for the Ford Motor Co., Dearborn, Mich., and a National Director of the American Foundrymen's Association, died March 31 at the Mercy Hospital in Bay City, Mich. He had suffered a cerebral hemorrhage March 27 while returning from a brief vacation trip.

A native of Michigan, he was born in Detroit, February 20, 1890. He attended Detroit University School and Detroit Central High School, and was graduated by the University of Michigan, Ann Arbor, in 1914 with the degree of Bachelor of Chemical Engineering. In 1937, the university awarded him an honorary degree, Master of Engineering.

Russell Hudson McCarroll

Following graduation, Mr. McCarroll was associated for a time with Solvay Process Co. and Semet Solvay Co., Detroit, prior to joining the chemical engineering staff of Ford Motor Co. at Highland Park in 1915. Placed in charge of chemical engineering at the Rouge plant in 1918, he served in that capacity until 1922, when his responsibilities were extended to cover chemical engineering at all Ford plants. He was named to his most recent position in 1944.

Long interested in the affairs of the A.F.A. and active in its Detroit chapter, Mr. McCarroll was elected a National Director at the business session of the 51st Annual Meeting in Detroit last year.

He was a contributor to the trade and technical press, for which he wrote many articles on manufacturing and metallurgical processes. He also prepared formal papers for technical and professional societies.

In additional to his A.F.A. affiliation, he held membership in the American Chemical Society, American Society for Metals, American Welding Society, Engineering Society of Detroit, Institute of Metals (British) and Society of Automotive Engineers. He served as a member of the technical board of the SAE, and as a director of the Engineering Society of Detroit.

Mail National Committee Roster

NATIONAL COMMITTEE PERSONNEL, officers and directors of the American Foundrymen's Association are listed in a roster recently issued by A.F.A. Sent to all A.F.A. members, committee members, and heads of companies represented in the technical committees, the roster lists over 450 men.

Listing of the committee members is by committee and division, and alphabetically with title and address. Pictures of chairmen and vice-chairmen of divisions, and chairmen of general interest committees, are included. A section of the roster describes committee selection and administration and gives suggested rules for division and committee procedure.

Divisional committee organization is shown on the back of the roster by means of a diagram. The relationship between the executive committee, the program and papers committee, the research committee, the advisory group, and the various committees and sub-committees is illustrated.

Foreign Visitors and Old Timers Have Special Registration Booth

SPECIAL REGISTRATION of "old timers" of the castings industry and of delegates from abroad will again be a Convention-week feature at the 52nd Annual Meeting in Philadelphia May 3 through 7.

A special book will be provided for those who have been in the field 25 years or more. Following registration, "old timers" will receive pins inscribed with "50 Years of Service" or "25 Years of Service." A book for "international registration" will be signed by members and visitors from Canada, Mexico and other lands.

A.F.A. will maintain a special booth in Association Headquarters (central hall, between Exhibit and Convention halls) for this registration, which has been one of the most interesting events of recent meetings. All "old timers" and those delegates who have traveled from other countries to attend the annual gathering of the Association, are invited to "sign up." A.F.A. is especially eager to welcome any who were delegates to the first Convention, Philadelphia, May 12-14, 1896, or who attended other meetings prior to 1910.

Second Engineering Progress Show At Franklin Hall in Philadelphia

PHILADELPHIA'S SECOND ANNUAL Engineering Progress Show, sponsored by the junior members of the Engineer's Club of Philadelphia and the Franklin Institute of Pennsylvania, will be held in Franklin Hall, May 11 through 14.

E. G. Bailey, national president of the American Society of Mechanical Engineers, will deliver the opening address. On the evening of May 13, T. P. Simpson, director of research, Socony-Vacuum Laboratories, will be the featured speaker.

Engineering Students Visit Plants

TWENTY-FIVE ENGINEERING STUDENTS from Pennsylvania State College visited the Perth Amboy and Newark, N.J., plants of Federated Metals Division of American Smelting and Refining Co. recently.

The visitations, a type of foundry educational activity becoming increasingly popular with many plants, are part of the company's long-range development program designed to foster the interest of educational groups in the technology and development of non-ferrous metals. The students saw the manufacture of brass, bronze and aluminum ingot, solder, babbit, type-metal, and zinc-base die-casting alloys.

Professors H. M. Davis and H. J. Read were in charge of the students, and W. T. Battis, plant superintendent at Perth Amboy, acted as host. At Newark, the students were escorted by Fred J. Menninger.

A method has been developed for the production of nodular graphite structures in cast irons without the necessity for applying heat-treatment as in the malleable cast iron process. Irons with these nodular structures are termed nodular cast irons. The process involves the treatment of a low sulphur hypereutectic cast iron with cerium shortly before casting. The cerium is conveniently added as misch metal, and functions first as a desulphurizer and second as a carbide stabilizer. With cerium treatment alone, only the hypereutectic graphite is nodular and the remainder of the graphite is in a new pattern referred to as "quasi-flake graphite." The hypereutectic nodules are of the spherulitic variety. Nodular cast irons with all of the graphite in the spherulitic form are obtained by treatment of the molten metal with cerium, followed by treatment with a graphitizing inoculant, such as ferro-silicon or silicon-manganese-zirconium. The process can be applied to irons of a wide range of composition, and examples have been given to illustrate the effects of some of the most important variables.

NODULAR GRAPHITE STRUCTURES PRODUCED IN GRAY CAST IRONS

H. Morrogh
British Cast Iron Research Association
Birmingham
England

RECENT RESEARCH WORK conducted in the laboratories of the British Cast Iron Research Association has been devoted, in part, to the investigation of the mechanism of graphite formation in cast iron. Arising from this work has been the development of a method (patents applied for in United States, Great Britain, and elsewhere) by which gray cast irons, having nodular graphite structures in the as-cast state, can be obtained without the necessity for applying any heat-treatment process subsequent to the solidification of the casting in the mold. Such irons, which may have all or part of their graphitic carbon contents in the nodular form, have been termed "nodular cast irons." It is the purpose of this paper to give a short account of this process and to illustrate the properties and the typical structures of the new material.

Preliminary work leading to this discovery has been previously described by Morrogh and Williams [1, 2] and recently a detailed account has been given of the development of the process and the theories behind it.[3]

Ordinary gray cast irons have their graphitic carbon distributed through the metallic matrix in the form of flakes, the size and shape of which vary considerably according to composition, cooling rate, method of melting, ladle treatment, etc. These graphite flakes interrupt the continuity of the metallic matrix and so render the material relatively brittle and non-ductile. In hypoeutectic cast irons two distinctly different forms of graphite flake distribution are possible.

A considerable measure of controversy exists as to the nomenclature of these graphite patterns, but the present author will refer to them as "normal flake graphite" for the one variety and as "undercooled graphite" for the other variety. There is substantial experimental evidence [1, 2, 4] to indicate that normal flake graphite is deposited directly from the melt along with austenite, and that undercooled graphite forms after solidification as the result of the decomposition of cementite.

In malleable cast irons, which are produced by the annealing of a white cast iron, the graphitic carbon, commonly termed temper carbon, exists in roughly spheroidal aggregates or nodules. These temper carbon nodules, by virtue of their approximately spheroidal shape, do not interrupt the continuity of the metallic matrix to the same extent as flake graphite and so, if the total carbon content is sufficiently low, a material of relatively good shock-resistance and ductility may be obtained. The author has shown [5] that two different forms of temper carbon nodule can occur in malleable cast iron according to the composition of the white iron being annealed.

Graphite Dispersion Varies

When the white iron has all its sulphur predominantly in the form of manganese sulphide, each nodule in the resulting malleable iron consists of an apparently random aggregate of small graphite flakes, the degree of dispersion of which may vary between wide limits. Lacking a better term, nodules of this type were referred to as "graphite-flake-aggregate" nodules, and a typical example of this structure is shown in Fig. 1.

Nodules of this type are commonly found in blackheart malleable cast iron, where the sulphur content usually is more or less balanced by the manganese content. However, in European whiteheart malleable cast iron, the manganese is frequently inadequate to balance the sulphur and so iron sulphide occurs in the material. Under these conditions the temper carbon

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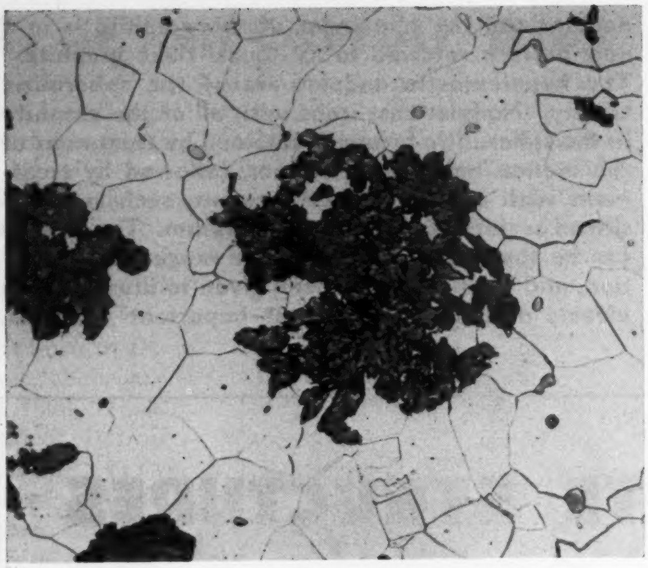


Fig. 1—Typical example of "graphite-flake aggregate" nodule in malleable cast iron having sulphur present as manganese sulphide. Etched in 5 per cent nital. ×300.

Fig. 2—Spherulitic nodule in malleable iron having sulphur present as FeS. Etched in picric acid. ×350.

has a spherulitic structure, a typical example of which is illustrated in Fig. 2. Spherulitic nodules are obtained in nodular cast irons and it is therefore of some interest and importance to understand and appreciate this graphite structure.

At this point it should be observed that these structures can be observed only in microspecimens in which the graphite itself is polished. A method for accomplishing this has been described, and the special properties of graphite which permit the internal structure to be observed have been discussed in some detail.[6]

Spherulitic structures are well known to the mineralogist, and graphite spherulites conform to the general structural characteristics common to all other spherulites. Nodules of graphite having this structure each consist of an aggregate of graphite crystallites radiating from a common center or nucleus. The closely packed basal planes of the graphite crystallites are, in general, oriented at right angles to the radii of the spheroid. Graphite spherulites tend to be more perfectly spheroidal in shape than the flake-aggregate nodules. It is important to reserve the term "spherulite" for aggregates having the radial fibre structure as illustrated in Fig. 2. Subsequently in this paper the term will have this connotation only.

Problem and Solution

It has long been the view that the mechanical properties of gray cast iron could be considerably improved if the graphite could be obtained in the nodular instead of the flake form. To do this would at first seem to require an iron which would solidify white and subsequently graphitize at some relatively low temperature after solidification. This condition is partly fulfilled in irons having undercooled graphite structures—they solidify white and graphitize very shortly after solidification.

Studies of the analogous nickel-carbon and cobalt-carbon systems[1, 2] enabled the author and his co-worker, Williams, to predict that it should be possible to obtain nodular structures, in cast irons which undercool, by the addition of a carbide stabilizing element so that carbide decomposition is retarded.

Furthermore, work on the analogous systems indicated that the element should be a desulphurizer and that low sulphur contents were likely to assist in achieving the desired structure. After a somewhat unusual method of investigation (which has been described elsewhere in detail[3]) it was found that additions of cerium to cast iron of appropriate composition would produce spherulitic nodular graphite structures.

Process Developed

The method which has been developed for the production of nodular cast irons involves in its simplest form the addition and solution of an appropriate amount of cerium to a molten cast iron of appropriate composition shortly before casting. The principal composition requirements for the production of nodular irons by this process are:

1. The iron must solidify gray even without the cerium addition.
2. The iron must be of hypereutectic carbon content, that is, the carbon content should exceed the value $4.3 - \frac{1}{3}$ (per cent Si + per cent P). When the nickel content of an iron exceeds 10 per cent, it need not be hypereutectic according to this formula.
3. Silicon content can have any value, but is preferably within the range 2.3–7 per cent.
4. Sulphur content of the metal to be treated should be as low as possible, and after treatment should be below about 0.015 per cent.
5. Phosphorus content should not exceed about 0.6 per cent, and should preferably be below 0.1 per cent.
6. Manganese, copper, nickel, chromium and molybdenum may be present in any amounts, singly or in any combination, provided condition No. 1 is observed.
7. After treatment with cerium the solidified castings must contain more than a certain minimum amount (0.02 per cent) of the element dissolved in the metallic matrix.

Of the foregoing requirements the most important from the point of view of the successful use of the process are those covering the carbon and sulphur contents.

Table 1—Mechanical Properties of Untreated [1] and Cerium-Treated [2] Cast Irons

Test Bar Diameter, in.	Transverse Rupture Stress, psi W/O Ce	Transverse Rupture Stress, psi With Ce	Deflection, in. W/O Ce	Deflection, in. With Ce	Tensile Strength, psi W/O Ce	Tensile Strength, psi With Ce	BHN W/O Ce	BHN With Ce	Impact Strength, ft-lb W/O Ce	Impact Strength, ft-lb With Ce	Compression Strength, psi W/O Ce	Compression Strength, psi With Ce	Shear Strength, psi W/O Ce	Shear Strength, psi With Ce
1.6	51,500	99,000	0.20	0.32	25,100	55,050	154	186			71,600	127,100		
1.2	64,500	101,500	0.28	0.38	32,050	55,500	160	198					36,500	49,700
0.875	68,870	105,400	0.18	0.23	37,200	59,550	162	199	12	43				
0.6	68,900	128,500	0.11	0.22	41,650	69,020	198	239			115,750	153,000		

[1] Analysis of remelted pig iron: total carbon 3.77; silicon, 3.05; manganese, 0.73; sulphur, 0.023; phosphorus, 0.039 per cent.

[2] Remelted pig iron with cerium additions: total carbon, 3.72; silicon, 3.13; manganese, 0.74; sulphur, 0.007; phosphorus, 0.038; cerium, 0.040 per cent.

The influence of cerium in cast iron has been investigated and discussed in the literature on several previous occasions.[7-18] Much of this evidence is conflicting, but two fairly well-established facts emerge from its study—cerium may be a potent carbide stabilizer under certain conditions, and when added to sulphur-containing alloys it is an effective desulphurizer. No previous investigators have claimed that nodular structures could be produced in cast irons by the addition of cerium, and this is understandable because in no case have all the composition requirements set out in the foregoing been met.

Cerium in Cast Iron

As a result of the present author's work, it has become apparent that the first major effect of cerium when added to molten cast iron is to combine with the sulphur to form a cerium-sulphur compound which floats to the surface of the metal. This accounts for the desulphurizing effect of the element. As long as the sulphur content of the metal is above about 0.015 per cent this desulphurizing action will take place. Cerium is not free to alloy with the metal until the sulphur content has reached this low value. The higher the sulphur content of the metal, the larger is the amount of cerium required to achieve desulphurization, and hence to obtain a given amount of cerium not combined with sulphur dissolved in the metal.

It is possible that deoxidation also accompanies desulphurization. At temperatures within the range of 1200-1600 C desulphurization with cerium proceeds quite rapidly, and relatively large quantities of metal may be desulphurized by this element in a few seconds.

After the sulphur content has been reduced to a value of about 0.015 per cent, metallic cerium enters into solution in the molten cast iron, and this cerium, when present in amounts greater than about 0.02 per cent, functions as a powerful carbide stabilizer. It is this dissolved cerium in excess of 0.02 per cent which is the operative factor in the process for the production of nodular graphite structures in the as-cast state.

Cerium Additions to Hypereutectic Cast Irons

When cerium is added to hypereutectic cast irons, and when the final sulphur content is below about 0.015 per cent and the cerium content of the metal is above about 0.02 per cent, all the hypereutectic graphite is obtained as well-formed spherulites. When the silicon content of such an iron is sufficiently high to prevent formation of the white iron eutectic, the graphite originating from the eutectic complex has an appearance resembling that of normal flake graphite.

This flakelike graphite has been termed "quasi-flake graphite" since it may on occasions have the appearance of flake graphite, but forms in a manner quite different from that of the normal variety. This difference will become more apparent in later sections of this paper.

To illustrate this effect of cerium on hypereutectic cast irons, the following example may be quoted. A 50-lb charge of hematite pig iron of the percentage analysis, total carbon, 3.98, silicon, 3.19, manganese, 0.78, sulphur, 0.028, and phosphorus, 0.040, was melted in a crucible furnace and cast, at a temperature of 1380 C, into test bars of four different sizes.* A further similar melt was carried out, but in this case a 28-gram addition of pure cerium was added to the molten metal before casting. Mechanical properties and chemical analyses of the two sets of bars are shown in Table 1.

Microstructures of all the untreated bars show mixtures of undercooled and normal flake graphite in matrices of ferrite with some pearlite—the amount of flake graphite increasing and the amount of pearlite decreasing with increasing section size. The microstructure of the untreated 1.2-in. bar is shown in Fig. 3. The treated bars all showed hypereutectic spherulites, together with quasi-flake graphite in a matrix of ferrite with some pearlite. The structure of the treated 1.2-in. bar is shown in Fig. 4.

Solidification of Cerium-Treated Hypereutectic Irons

The structure shown in Fig. 4 is, judged by previous standards, completely novel and, bearing in mind the distribution of the graphite, it is easily understandable that the mechanical properties of the treated material are at a distinctly higher level than those of the untreated material. It is to be observed in Table 1 that, even with this simple cerium addition to a high carbon and relatively high silicon iron, a material is obtained which immediately falls into the category of a high-duty cast iron.

Mechanism of solidification of the type of structure illustrated in Fig. 4 has been studied and a fairly clear picture of the process obtained.[3] The hypereutectic spherulitic nodules form in the melt before solidification of the metallic phases begins. It is not known for

* The transverse, deflection and tensile figures given in this paper for 2.1, 1.6, 1.2, 0.875 and 0.6-in. diameter bars were obtained on bars cast and tested according to British Standard Specification 786/1938; the impact figures were obtained on bars tested according to British Standard Specification 1349/1947; the 3-in. diameter bars were tested in transverse on 18-in. centers.

certain whether these graphite spherulites are deposited directly from the melt or whether they form by the decomposition of a carbide phase. While the possibility of the latter has to be considered, it is not easy to imagine and it involves a case of extremely rapid carbide decomposition.

The remainder of the melt solidifies as a "eutectic" or, more correctly, a binary complex of austenite and cementite which decomposes shortly after solidification to give the quasi-flake graphite. The presence of the hypereutectic spherulites appears to initiate the rapid decomposition of the "eutectic" cementite after solidification of the iron.

It will be observed in Fig. 4 that the hypereutectic nodules are surrounded in each case by a volume of metal entirely free from the quasi-flake graphite. The reason for this becomes apparent when these nodules are examined at a high magnification, when each is found to have, in addition to the characteristic radial spherulitic structure, a duplex structure consisting of a central spherulite of nodular graphite surrounded by a peripheral layer of graphite.

Such a duplex structure is seen in Fig. 5, which shows a hypereutectic spherulite in a cerium-treated iron at a fairly high magnification. This micrograph has been taken under plane polarized light. The central core of this duplex nodule represents the actual hypereutectic graphite, and the peripheral layer the graphite arising from the decomposition of the surrounding "eutectic" cementite which has crystallized onto the hypereutectic spherulite. This explains the absence of quasi-flake graphite in the vicinity of each nodule in Fig. 4.

Each hypereutectic nodule appears to have a "sphere of influence" within which all further graphite is made to crystallize on the existing hypereutectic nucleus. This thought provides the clue to the complete development of the cerium process for the production of nodular cast irons by which the whole of the graphite can be obtained in the nodular form.

This final stage of the process will be described later in this paper but, following what has been said so far in this section, it will be seen that if the number of hypereutectic spherulites in a given volume of metal could be so increased that all their "spheres of influence" overlapped, then all of the graphite should occur in the form of duplex spherulitic nodules with a further improvement in mechanical properties. A preliminary indication of the validity of this latter idea is found by studying the structures of centrifugally cast cerium-treated cast irons.

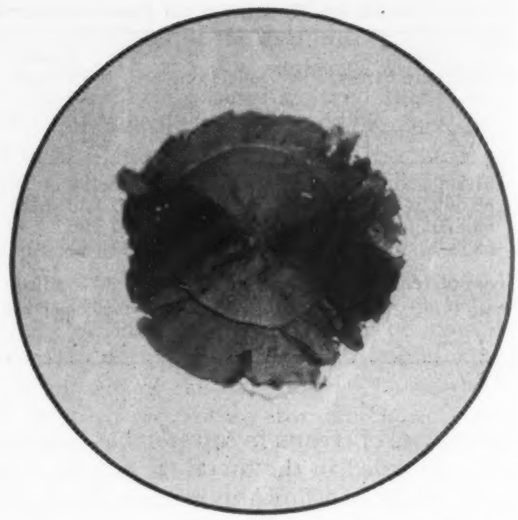


Fig. 5—Duplex structure of hypereutectic spherulite present in cerium-treated iron. Unetched. ×1500.

When cerium-treated hypereutectic cast irons are centrifugally cast, the hypereutectic spherulites forming in the liquid are forced to points most distant from the mold face, by virtue of their low relative density. In the centrifugal casting of cylinder liners, for instance, a segregation of these nodules is obtained along the inner surface of the casting. By this segregation the number of hypereutectic nodules is thus artificially increased so that their "spheres of influence" overlap.

Figure 6 shows a typical segregation of these hypereutectic spherulites near the inner surface of a centrifugally cast cylinder liner made in a cerium-treated hypereutectic cast iron. It will be seen that no quasi-flake graphite occurs in the vicinity of this segregation.

Fig. 3—General structure of untreated remelted pig iron, 1.2-in. test bar. Etched in picric acid. ×100.

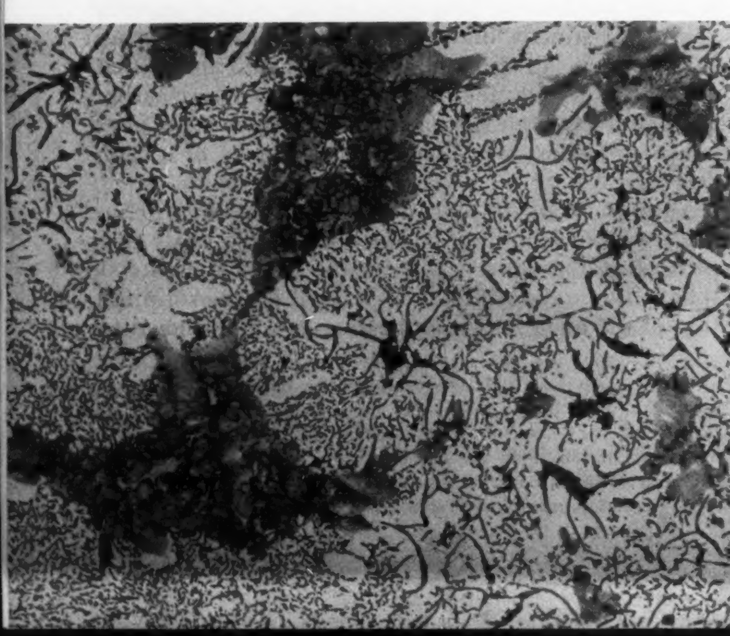
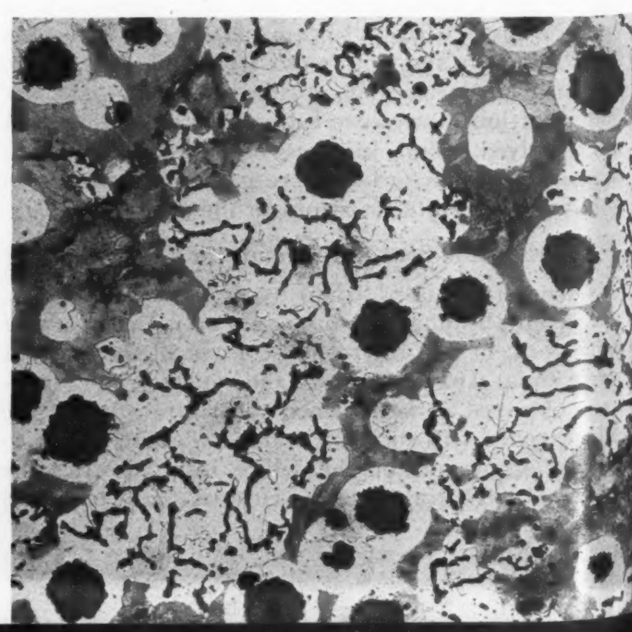


Fig. 4—Microstructure of cerium-treated remelted pig iron, 1.2-in. test bar. Etched in picric acid. ×100.



At points nearer the mold face containing very few hypereutectic nodules, all of the graphite was in the form of quasi-flakes, as illustrated in Fig. 7.

These two micrographs clearly indicate that entirely spherulitic nodular graphite structures can be achieved by increasing the number of hypereutectic spherulites. This ideal structure of spherulitic nodular graphite has been obtained by the use of what will be referred to later as the "double-treatment process."

Adding Cerium to Cast Iron

In the example already given the cerium was added to the molten cast iron in the form of the pure element. In this form cerium is a very expensive addition, but it can be added in a variety of cheaper forms, among which misch metal is perhaps the most convenient. Misch metal used by the author has been found to contain between 43 and 50 per cent cerium, together with the other rare earths and a little iron and manganese. The presence of these other elements does not influence the efficacy of cerium in producing nodular structures in cast irons, and for this purpose they can be ignored.

Misch metal, in pieces of appropriate size, dissolves readily in cast irons at all temperatures above 1200 C. Its solution in cast iron is not explosive or violent in any way. Misch metal has been used as a cerium addition in all the remaining examples quoted.

Cerium Additions—Influence of Amount

Cerium not combined with sulphur in cast iron is a powerful carbide stabilizer, and so, for any given section size, there is an upper limit of cerium which must not be exceeded if white iron structures are to be avoided. This remark applies only to the cerium content as found by analysis of the solidified casting when the sulphur content is not in excess of about 0.015 per cent. Because of the carbide stabilizing influence of cerium its effect can best be studied in relatively large sections.

To illustrate the effect of increasing additions of cerium, 270 lb of a pig iron of the following composition was melted in an oil-fired crucible furnace: total carbon, 3.79; silicon, 2.80; manganese, 0.53; sulphur, 0.028, and phosphorus, 0.015 per cent.

Five test bars, each of 21-in. length and 3-in. diameter, were cast in green sand molds. For this, five lots of metal each weighing 50 lb were taken from the furnace. No addition was made to the metal in the first ladle, but increasing amounts of misch metal were added to the metal in the remaining four ladles. The actual additions were: Tap 1—no addition; Tap 2—50 grams misch metal; Tap 3—65 grams misch metal; Tap 4—90 grams misch metal; Tap 5—100 grams misch

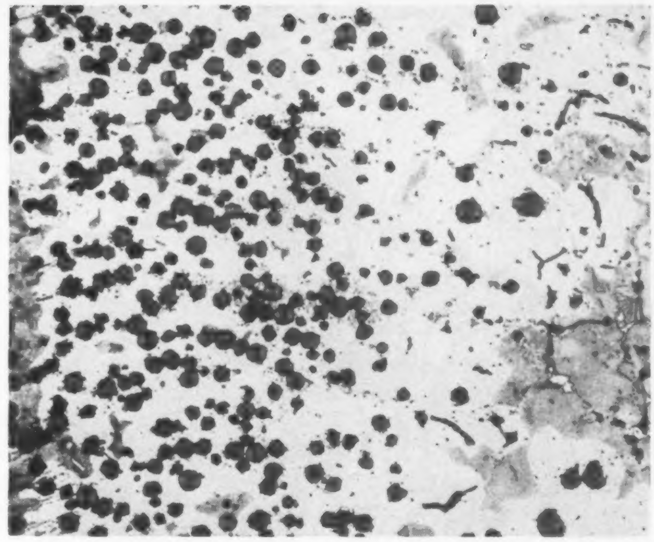


Fig. 6—Typical segregation of hypereutectic spherulites at inner surface of centrifugally cast cylinder liner (cerium-treated iron). Etched in picric acid. ×100.

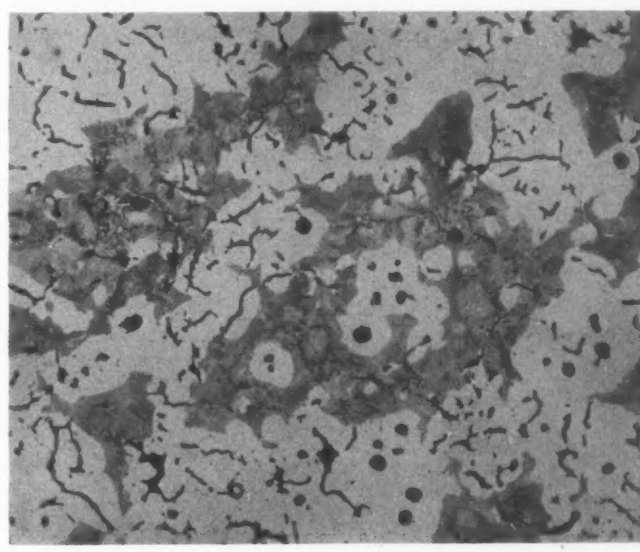


Fig. 7—Centrifugally cast liner. Structure at a point distant from inner surface. All graphite is in form of quasi-flakes. Etched in picric acid. ×100.

metal. The mechanical properties and cerium analyses of these bars are given in Table 2.

Transverse rupture stress, deflection and tensile strength show a progressive improvement with increasing cerium content. The microstructures of these bars also showed a progressive change with increasing cerium content. The untreated bar No. 1 had coarse flake graphite in a matrix of ferrite with some pearlite, as is shown in Fig. 8; bar No. 2 had a few hypereutectic spherulites with quasi-flake graphite, as illustrated in Fig. 9; with increasing amounts of cerium in bars Nos. 3, 4 and 5 the quasi-flake graphite became more nodular in appearance until bar No. 5 had the structure shown in Fig. 10.

That quasi-flake graphite differs from normal flake graphite is made clear when Figs. 8 and 9 are com-

TABLE 2—MECHANICAL PROPERTIES AND CERIUM ANALYSES

Bar No.	Transverse Rupture Stress,* psi.	Deflection,* in.	Tensile Strength, psi	BHN	Ce, percent
1	30,470	0.21	15,000	98	Nil
2	85,080	0.21	40,100	167	0.040
3	104,100	0.35	50,200	176	0.053
4	106,600	0.34	53,800	181	0.072
5	115,600	0.42	58,850	179	0.101

*Tested on 18-in. centers.

pared, and when the enormous difference in mechanical properties between bars Nos. 1 and 2 are considered. The relative amounts of ferrite and pearlite did not change appreciably with increasing cerium content, but in spite of this there was a sharp increase in hardness when the structure changed from the normal to the quasi-flake graphite.

Double-Treatment Technique Developed

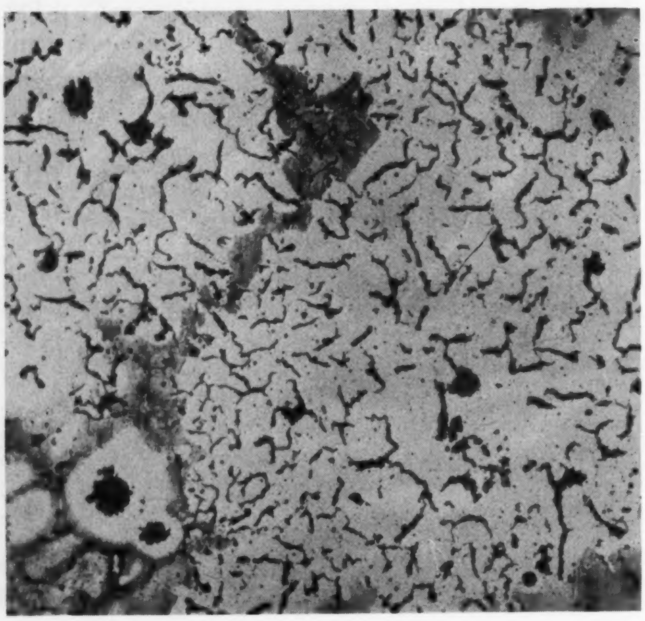
The influence of relatively large amounts of cerium in causing the aggregation of the quasi-flake graphite can be utilized only in relatively large sections. For thin sections, alternative methods must be applied to obtain an entirely nodular structure. It was shown earlier in this paper that, if the number of hyper-eutectic nuclei could be increased, all of the graphite would occur in spherulitic nodular form and the quasi-flake graphite would be avoided.

A process for the production of this ideal structure has now been developed, entailing the addition of a graphitizing inoculant simultaneously with, or preferably after, the cerium addition. This treatment of the molten metal will be referred to as the "double treatment" process. Suitable graphitizing inoculants have been found to be 80 per cent ferro-silicon, silicon-manganese-zirconium, and calcium silicide, the best response having been obtained with the first and second. It is important that the inoculant is not added before the cerium addition as the success of the operation depends upon obtaining the solution of the cerium before the inoculant.

Owing to the extremely rapid rate of solution of misch metal in cast iron, this condition may be achieved even when the inoculant and misch metal are added simultaneously. For the inoculant to have the required effect it is necessary to add sufficient, in the case of silicon-manganese-zirconium or ferro-silicon, to give a definite increase in silicon of not less than about 0.2 per cent, but no useful purpose is served by using amounts giving silicon yields in excess of 0.5 per cent.

Results given in Table 3 illustrate the effect of adding varying amounts of 80 per cent ferro-silicon for the same addition of misch metal in each case. These figures are average values, obtained from four 1.2-in. bars cast in each case from 50 lb of metal treated as follows: Tap 1—70 grams misch metal: Tap 2—70 grams misch metal + 2 oz 80 per cent ferro-silicon; Tap 3—70 grams misch metal + 4 oz 80 per cent ferro-silicon; Tap 4—70 grams misch metal + 8 oz 80 per cent ferro-silicon.

Transverse rupture stress, tensile strength and impact strength show a marked increase with the first addition of inoculant (compare bars 1 and 2). The impact results are particularly striking—these figures are obtained on a 0.798-in. diameter unnotched test piece which rarely gives a value in excess of 30 ft-lb for high-duty gray cast iron, and only occasionally a value as high as 50 ft-lb for the acicular gray cast iron.



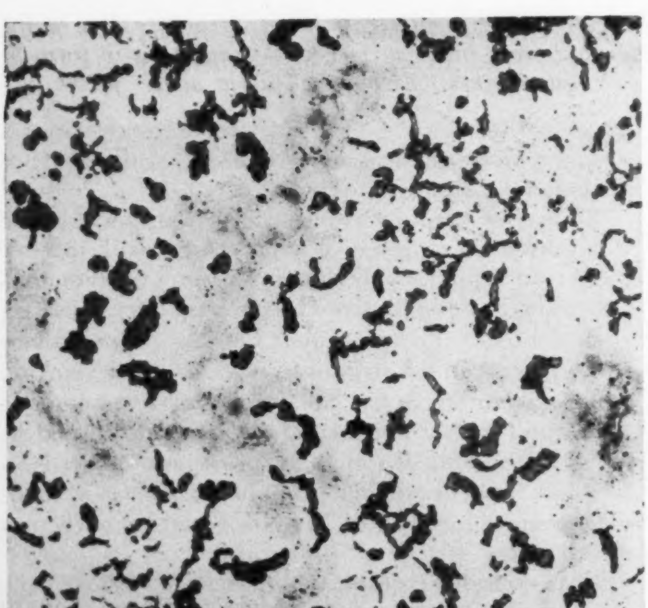


Fig. 8 (top)—Untreated remelted hematite pig iron cast in 3-in. diameter bar. Etched in picric acid. ×60.

Fig. 9 (center)—Remelted pig iron with 0.040 per cent Ce, cast in 3-in. diameter bar. Picric acid etch. ×60.

Fig. 10 (bottom)—Remelted hematite with 0.101 per cent Ce, cast in 3-in. diameter bar. Picric acid etch. ×60.

TABLE 3—EFFECT OF 80 PER CENT FERRO-SILICON ADDITIONS

Tap No.	Composition, per cent						Transverse Rupture Stress, psi	Deflection, in.	Tensile Strength, psi	BHN	Impact, ft-lb
	T.C.	Si	Mn	S	P	Ce					
1	3.67	2.67	0.86	0.005	0.051	0.040	127,200	0.60	58,200	221	54
2	3.52	2.73	—	—	—	0.051	138,000	0.60	71,000	233	91
3	3.49	2.89	—	—	—	0.058	138,900	0.60	74,800	238	84
4	3.50	3.03	—	—	—	0.061	142,000	0.77	75,700	231	70

Microstructures of typical bars from these four taps are shown in Figs. 11, 12, 13 and 14. The bar from Tap 1 (Fig. 11) is seen to have partially aggregated quasi-flake graphite; the bar from Tap 2 (Fig. 12) has many spherulitic nodules with only a little quasi-flake graphite; the bar from Tap 3 (Fig. 13) has an almost entirely nodular structure; the bar from Tap 4 (Fig. 14) has only a little quasi-flake graphite. The matrix structure does not differ greatly through this series.

Similar results can be obtained when the metal is treated simultaneously with the cerium addition and the inoculant, as is shown by the following example. A mixture of 70 grams of misch metal and 6 oz of silicon-manganese-zirconium was placed in the bottom of a ladle and 60 lb of metal run onto it. Four bottom-run 1.2-in. bars were cast and their average mechanical properties and the analysis of one bar are:

Chemical Analysis, per cent	
Total Carbon	3.71
Silicon	2.96
Manganese	0.54
Sulphur	0.010
Phosphorus	0.033
Cerium	0.051
Mechanical Properties	
Transverse Rupture Stress, psi	140,900
Deflection, in.	0.60
Tensile Strength, psi	72,100
Brinell Hardness Number	241
Impact Strength, ft-lb	71

The microstructure of one of these bars is shown in Fig. 15, and is seen to have spherulitic nodules with only a trace of quasi-flake graphite in a matrix of pearlite and ferrite.

Application of the double treatment process tends to offset the carbide stabilizing influence of the cerium and hence to reduce the danger of chilling. This effect automatically permits the use of higher percentages of cerium in the solidified casting, a factor which in addition helps to improve the structure of the material.

To illustrate the reduction in chilling tendency with the double treatment technique, the following example may be cited. A wedge test piece having the dimensions of one inch at base, 2 in. from apex to base, and 6 in. long was cast in a dry sand mold. This wedge was fractured transversely and gave a chilled zone approximately ¾-in. deep. The analysis of this wedge was: total carbon, 3.77; silicon, 2.69; manganese, 0.56; sulphur, 0.011; phosphorus, 0.024; and cerium, 0.061 %. In this case no double treatment was applied, and the white iron structure of the apex of the wedge is shown in Fig. 16. Only a trace of hypereutectic graphite can be seen. The structure ⅜-in. from the apex is shown in Fig. 17 and, while rather more graphite can be seen, the structure still is predominantly white.

On the other hand, when a similar wedge of the composition total carbon, 3.70; silicon, 2.73; manganese, 0.59; sulphur, 0.008; phosphorus, 0.055; and cerium, 0.061 per cent was cast after the application of the double treatment process, it showed no visible chill when fractured. The structure of the apex of this wedge is shown in Fig. 18, where only a very small amount of carbide can be seen. At a point ⅛-in. from the apex only traces of free cementite existed, as is shown in Fig. 19.

It appears that an optimum amount of cerium is necessary, even with the double treatment technique, to cause the structure to be entirely nodular. When the cerium content is below this value quasi-flake graphite may persist in the structure. This is shown by the results given in Table 4, and the structures shown in Figs. 20, 21, 22 and 23. Table 4 gives the analyses and mechanical properties of two sets of test bars prepared by treating two 50-lb taps of metal poured from the same melt with the following additions: Set 1—40 grams misch metal followed by 5 oz silicon-manganese-zirconium; Set 2—60 grams misch metal followed by 5 oz silicon-manganese-zirconium.

Microstructures of the 1.2-in. bars are shown in Figs. 20 and 21, and those of the 0.6-in. bars in Figs. 22 and 23. The 1.2-in. and 0.6-in. diameter bars of Set 1 clearly have some quasi-flake graphite, whereas this form of graphite is entirely absent and the structure is wholly nodular in the bars from Set 2.

Various Examples of Nodular Cast Irons

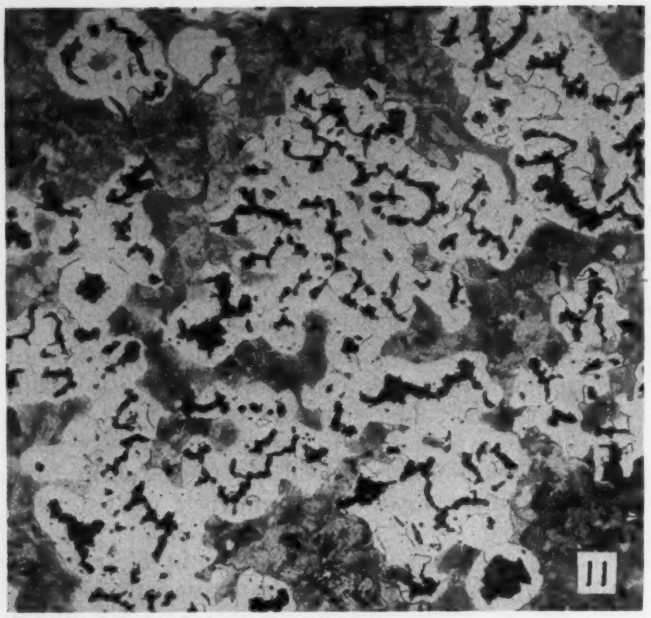
Example 1—With silicon contents below about 2.3 per cent and in the absence of other graphitizing elements, the chilling tendency of cerium-treated nodular irons, even when the double treatment process is applied, is so great that very careful control is necessary in order to avoid chilling in sections of less than ¾-in.

TABLE 4—ANALYSES AND MECHANICAL PROPERTIES—CERIUM AND SILICON-MANGANESE-ZIRCONIUM ADDITIONS

	Composition, per cent					
	T.C.	Si	Mn	S	P	Ce
Set 1	3.90	2.96	0.51	0.006	0.024	0.016
Set 2	3.90	3.10	0.52	0.007	0.023	0.031

Set No.	Bar Size, in.	Transverse Rupture Stress, psi	Deflection, in.	BHN	Impact strength, ft-lb	Tensile Strength, psi
1	1.6	104,500	0.51	179	32	54,800
	1.2	114,100	0.68	189	46	62,700
	0.875	122,900	0.39	213	76	65,100
	0.6	142,000	0.35	239	—	75,900
2	1.6	133,900	0.90	190	89	73,500
	1.2	143,000	1.02	199	>120*	73,900
	0.875	153,900	0.66	231	>120*	77,300
	0.6	164,000	0.43	252	—	98,100

* Full capacity of the Izod impact machine used is 120 lb.



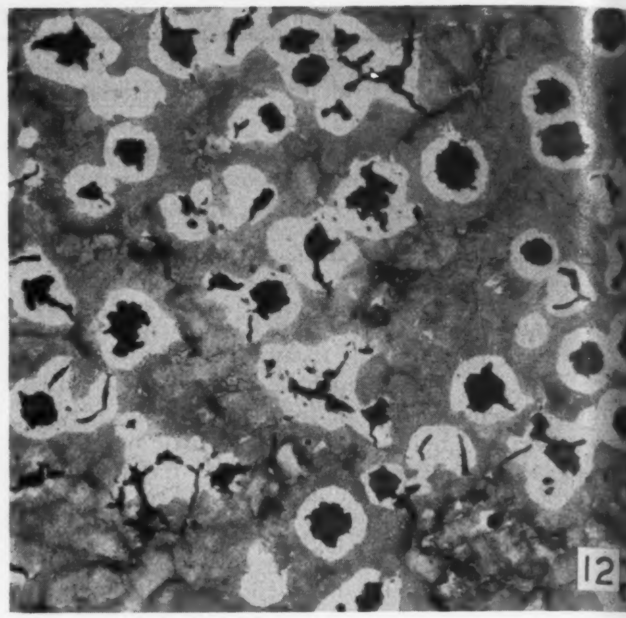


Fig. 11—General structure of 1.2-in. bar with Ce addition (No. 1, Table 3). Etched in picric acid. ×100.

Fig. 12—Microstructure of typical 1.2-in. bar with cerium and ferro-silicon addition (No. 2, Table 3). Picric acid etch. ×100. Note many spherulitic nodules.

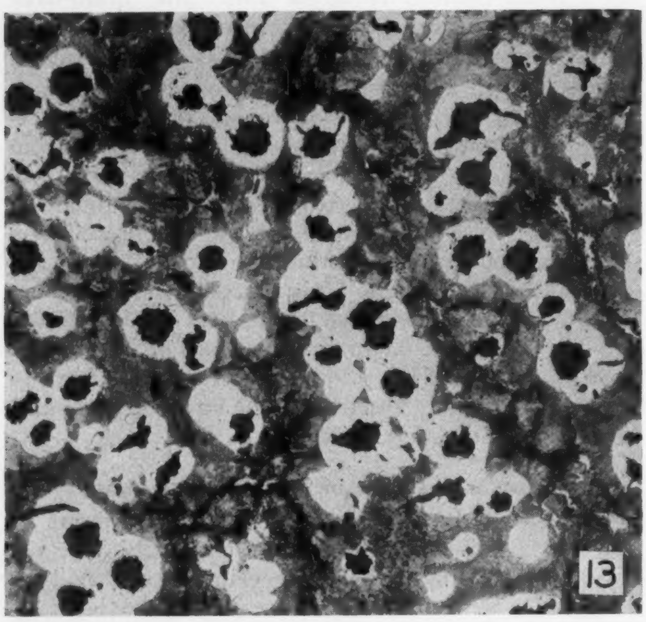
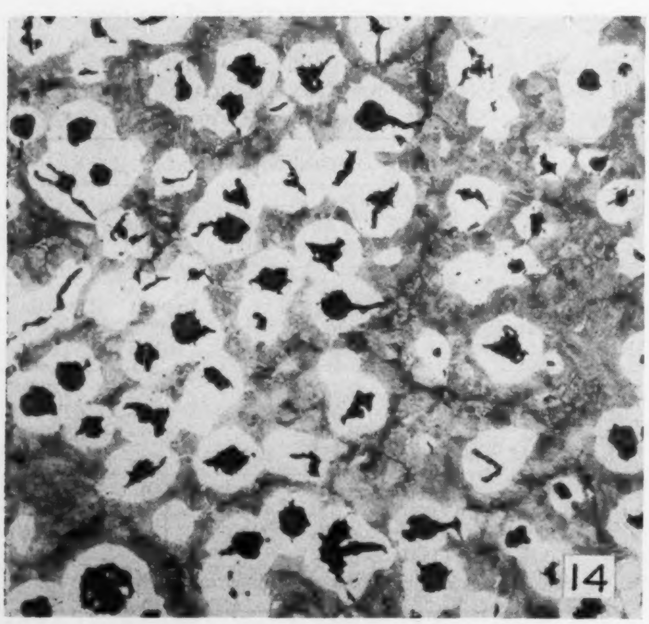
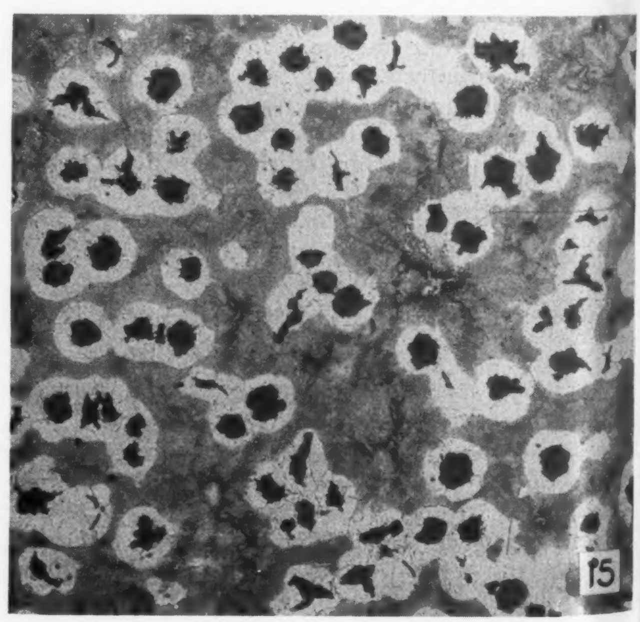


Fig. 13—Structure of 1.2-in. bar with cerium and ferro-silicon addition (No. 3, Table 3) is almost entirely nodular. Etched in picric acid. ×100.

Fig. 14—Photomicrograph of 1.2-in. bar with cerium and ferro-silicon addition (No. 4, Table 3) shows small amount of quasi-flake graphite. Picric acid etch. ×100.

Fig. 15—Metal treated simultaneously with misch metal and silicon-manganese-zirconium shows spherulitic nodules with only a trace of quasi-flake graphite in pearlite and ferrite matrix. Etched in picric acid. ×100.





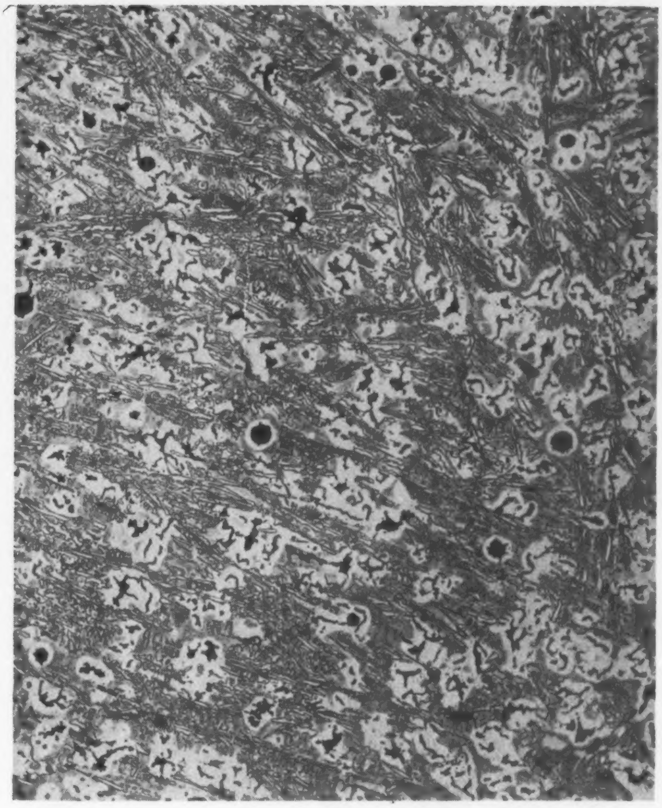
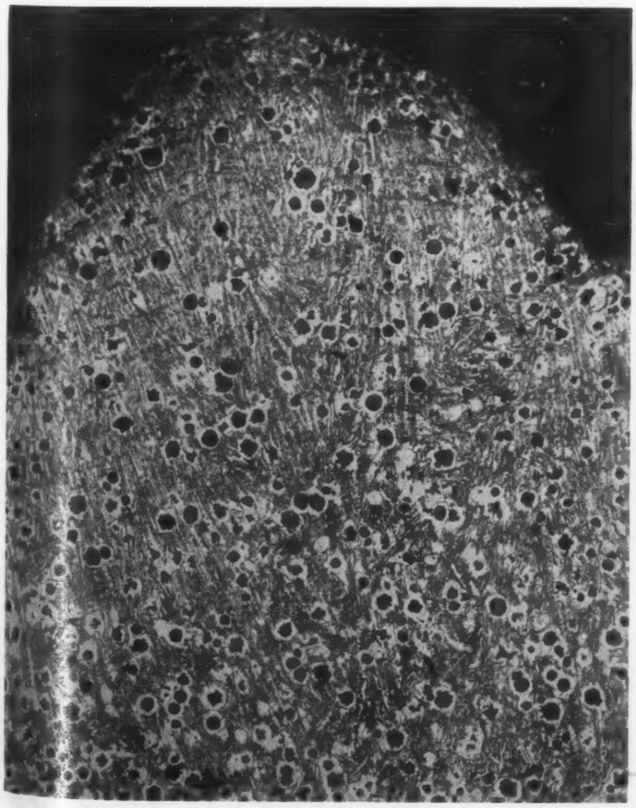


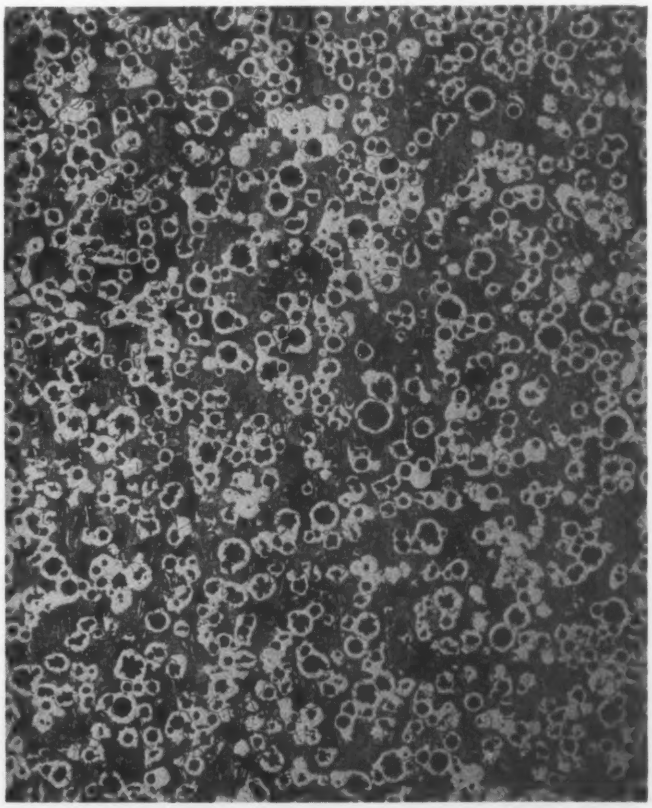
Fig. 16—White iron structure at apex of chill wedge made from metal treated with cerium alone shows only a trace of hypereutectic graphite. Picric acid etch. ×60.

Fig. 17—Structure of chill wedge, 3/8-in. from apex, treated with cerium alone, shows rather more graphite but still is predominantly white. Picric acid etch. ×60.

Fig. 18—Apex of chill wedge, cast from double-treated metal, shows only a very small amount of carbide in the structure. Etched in picric acid. ×60.

Fig. 19—Chill wedge structure, 1/8-in from apex, cast from double-treated metal, shows presence of only small amount of free cementite. Picric etch. ×60.





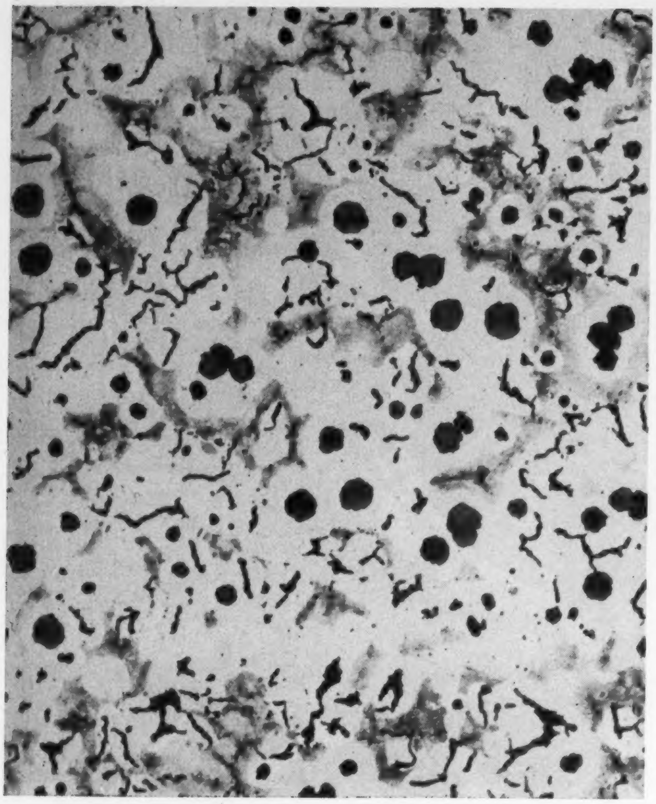


Fig. 20—Structure of 1.2-in. bar (No. 1, Table 4) with 0.016 per cent Ce, produced by double treatment process. Some quasi-flake graphite. Picric acid etch. ×100.

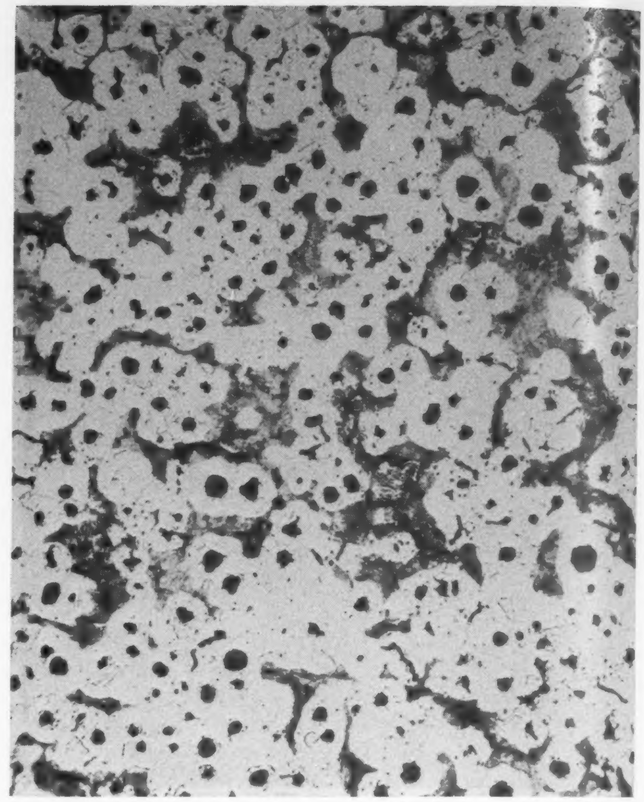
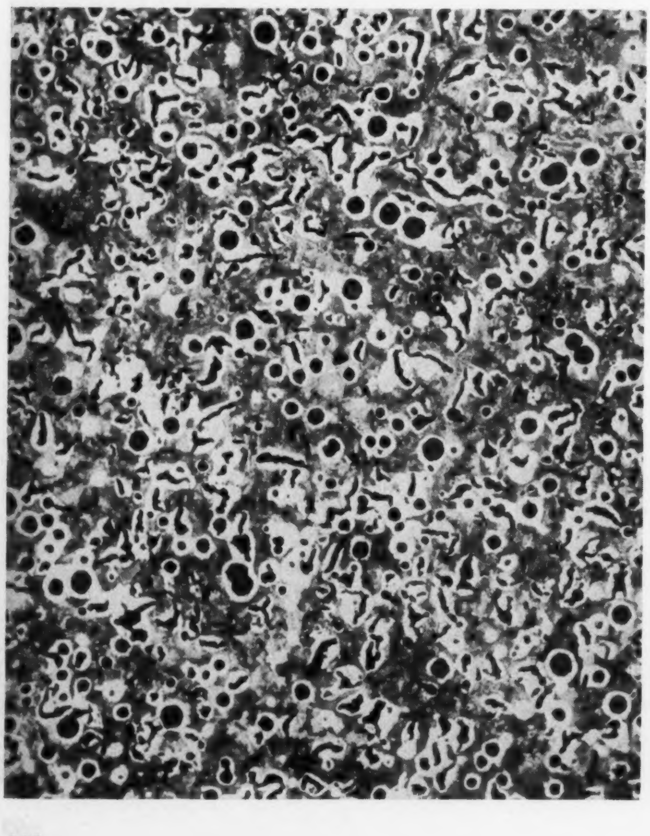


Fig. 21—Wholly nodular structure of 1.2-in. bar (No. 2, Table 4) with 0.031 per cent Ce, produced by double treatment process. Etched in picric acid. ×100.

Fig. 22—Microstructure of 0.6-in. bar (No. 1, Table 4) with 0.016 per cent Ce, double treatment process, shows some quasi-flake graphite. Picric acid etch. ×100.

Fig. 23—Structure of 0.6-in bar (No. 2, Table 4) with 0.031 per cent Ce, produced by double treatment process, shown to be wholly nodular. Picric acid etch. ×100.



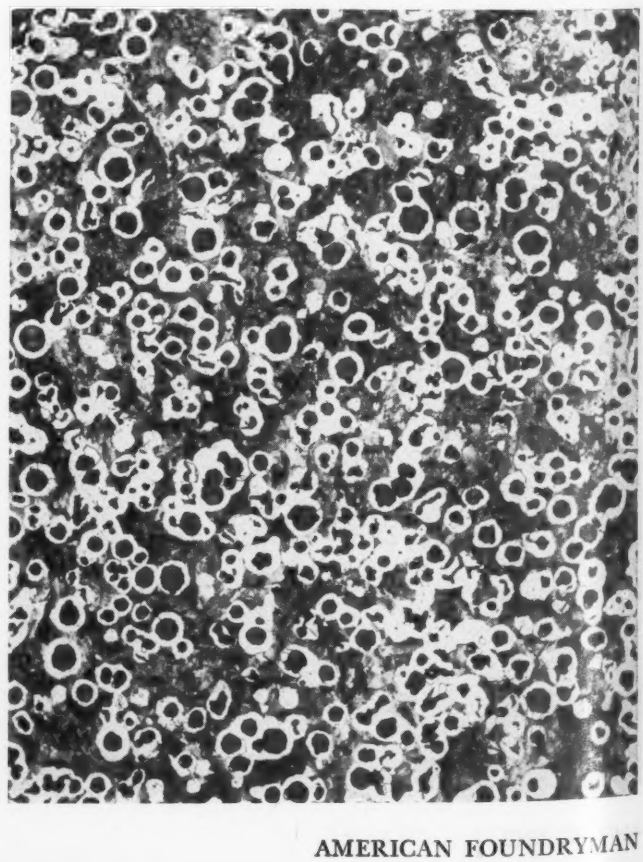


Table 5—Mechanical Properties of Double Treated Nodular Iron

Bar Size, in.	Transverse Rupture Stress, psi	Deflection, in.	Tensile Strength, psi	BHN	Impact Strength, ft-lb
1.6	150,900	0.30	89,000	260	88
1.2	157,000	0.40	79,200	288	92
0.875	181,000	0.30	96,500	302	94
0.6	206,500	0.27	114,000	333	—

However, when any deficiency of silicon is compensated for by the presence of appropriate amounts of copper and/or nickel a material of very good mechanical properties can be obtained, even in relatively thin sections. An example of this type is illustrated by the results given in Table 5, which are taken from a double treated nodular iron of the following composition: total carbon, 3.80; silicon, 2.17; manganese, 0.92; sulphur, 0.015; phosphorus, 0.052; cerium, 0.054; and copper, 2.17 per cent.

The general structure of the 1.6-in bar from this set is shown in Fig. 24 to consist of spherulitic nodules associated with ferrite in a matrix of pearlite. Figure 25 shows a spherulitic nodule in the 0.6-in. bar at a high magnification—the radial structure can be clearly seen. Occasionally in such samples the duplex structure of the nodules is revealed in a quite interesting manner. A typical instance of this is shown in Fig. 26, which shows a duplex nodule in the 1.6-in. bar. The central hypereutectic nucleus can be clearly seen with the remainder of the graphite, still in the spherulitic form, attached to the nucleus at only a few points.

Example 2—The double treatment can be applied and useful mechanical properties obtained with silicon contents as high as 6 per cent. With increasing silicon up to about 5 per cent the transverse rupture strength, tensile strength and Brinell hardness number do not change appreciably, but the shock-resistance drops progressively. The following figures, obtained on a fairly high silicon iron, illustrate the type of results which can be obtained:

Chemical Analysis—Total carbon, 3.14; silicon, 4.13; manganese, 0.85; sulphur, 0.004; phosphorus, 0.046; cerium, 0.051 per cent.

Mechanical Properties (1.2-in. diameter bar)—Transverse rupture stress, 141,500 psi; deflection, 0.38 in.; tensile strength, 77,500 psi; Brinell hardness, 234; impact strength, 29 ft-lb.

The microstructure of this sample consisted of spherulitic nodules in a matrix of ferrite with a little pearlite,

Fig. 25—Spherulitic nodule at high magnification in 0.6-in. bar (Table 5) in copper-containing double-treated iron. Note radial structure. Picric etch ×1250.

Fig. 26—Photomicrograph showing duplex structure of nodule in 1.6-in. bar (Table 5) in copper-containing double-treated iron. Etched in picric acid. ×500.

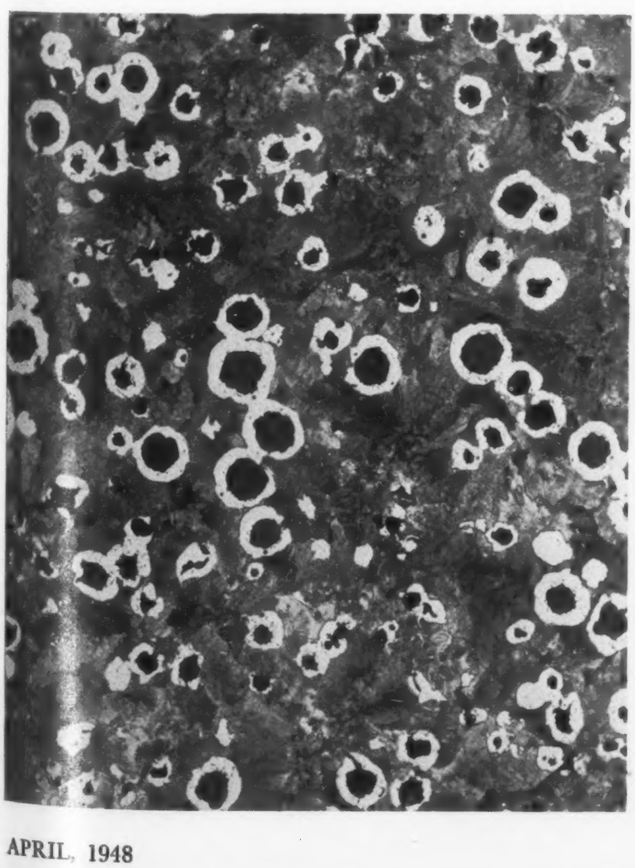


Fig. 24—Structure of 1.6-in. bar (Table 5) in copper-containing double-treated iron, shows spherulitic nodules in matrix of pearlite. Etched in picric acid. ×100.

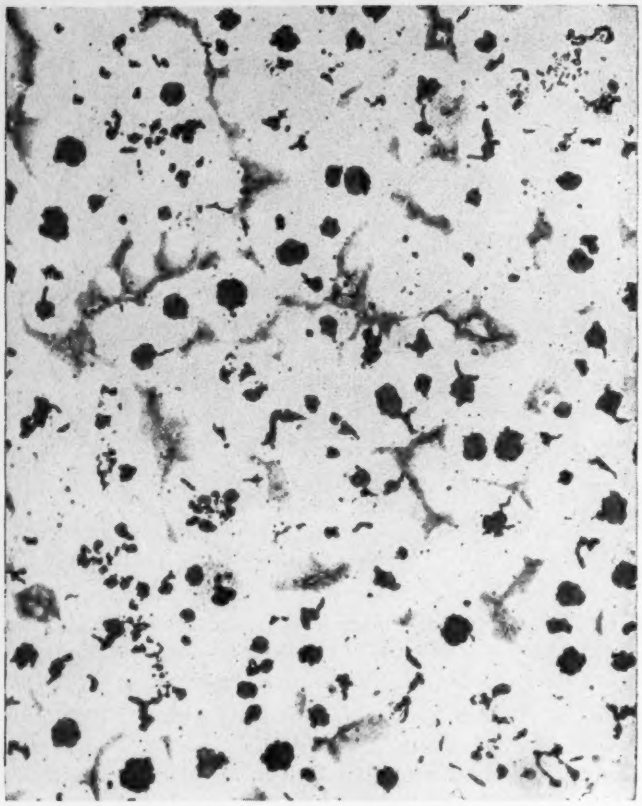


Fig. 27—*Microstructure of nodular iron with 4.13 per cent silicon content. Etched in picric acid.* ×*100.*

as is shown in the photomicrograph of Fig. 27 at ×100.

Example 3—The use of cerium for the production of nodular cast irons cannot be extended to phosphorus contents in excess of about 0.5 per cent because this element appears to lower the solubility of cerium in the melt. At relatively high temperatures (in excess of 1450 C) the cerium dissolves readily, but on cooling it is deposited from the melt at a temperature of about 1380 C in the form of a cerium-rich alloy.

For instance, 50 lb of a phosphoric pig iron was melted in a crucible furnace and treated with 100 grams of misch metal when at a temperature of 1470 C. The addition appeared to dissolve readily, but as the metal cooled prior to pouring a thick scum developed on the surface of the metal. This was skimmed off and the rest of the metal poured into test bars. The scum and the test bars gave the following figures on subsequent analysis:

	Composition, per cent	
	Scum	Metal Poured
Total Carbon	3.33	3.46
Silicon	2.37	2.61
Manganese	0.72	0.84
Sulphur	0.076	0.036
Phosphorus	1.20	1.44
Cerium	4.80	Not detected

Obviously, there is a considerable segregation of cerium and sulphur in the material skimmed from the surface of the liquid metal.

Although nodular structures can be obtained with up to 0.50 per cent phosphorus, the mechanical properties fall off progressively with increasing amounts of this element. The results shown in Table 6 give the mechanical properties of a fairly high phosphorus iron of the following composition: Total carbon, 3.60; silicon, 2.67; manganese, 0.54; sulphur, 0.007; phosphorus, 0.50; cerium, 0.031 per cent.

This metal was treated with misch metal alone—the double treatment was not applied. The results obtained may therefore be compared with those in Table 1. The microstructure of the 1.2-in. bar from this series had large hypereutectic spherulites and quasi-flake graphite in a matrix of pearlite with phosphide eutectic. This structure is shown in Fig. 28.

High Manganese Irons

Example 4—Provided that the iron will solidify gray before treatment the manganese content of a nodular cast iron may have any value. The general effect of increasing amounts of manganese is to inhibit the formation of ferrite, even with fairly high silicon contents, and ultimately to give entirely pearlitic structures and, if sufficient of the element is present, to give martensitic structures. The results given in Table 7 show the tensile strength and hardness of two relatively high manganese nodular irons produced by the double treatment process. These high manganese irons were cast in the form of 1.2-in diameter bars.

Bar No. 1, containing 2.01 per cent manganese, had a microstructure consisting of uniformly distributed spherulitic nodules in a matrix of about 70 per cent pearlite and 30 per cent ferrite. The graphite structure of bar No. 2 was very similar to that of bar No. 1, but the matrix in this case was almost entirely pearlitic with a small amount of martensite and a little carbide. The structure of bar No. 2 is illustrated in Fig. 29.

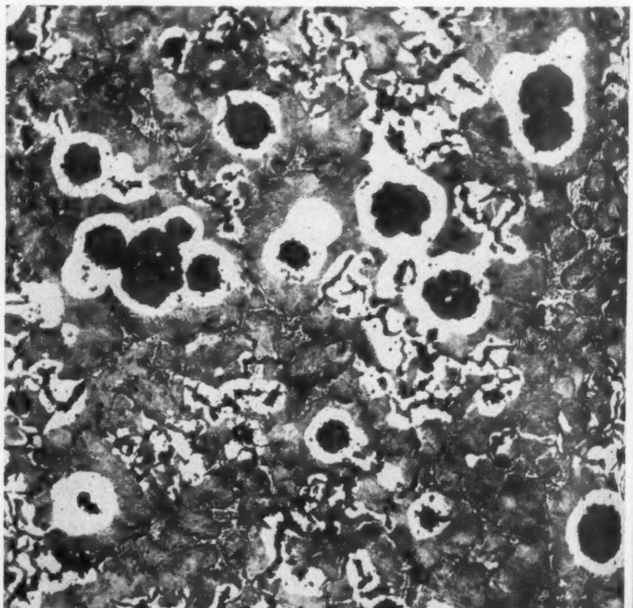


Fig. 28—*Photomicrograph showing structure of 1.2-in. bar (Table 6) in single treatment nodular iron with 0.50 per cent phosphorus. Picric acid etch.* × *100.*

The tensile strength and hardness values of the irons are seen to increase as the structure becomes pearlitic.

Example 5—High manganese nickel-containing austenitic irons may be treated with cerium to give nodular structures with a considerable improvement in mechanical properties. This is illustrated by the results given in Table 8, which show the mechanical properties of an untreated and a cerium-treated nickel-manganese austenitic iron. The double treatment was not applied in this case. The untreated material had a structure of coarse flake graphite in a matrix of austenite, and the treated material had a nodular structure in a similar matrix with a little carbide.

Treating Nickel-Containing Irons

Example 6—When the nickel content of nodular cast iron exceeds about 10 per cent it is not necessary for the iron to be hypereutectic according to the formula: per cent C $= 4.3 - (\frac{1}{3}$ per cent Si $+$ per cent P). Therefore the treatment can be readily applied to ordinary nickel-containing austenitic irons. In Table 9 the chemical analyses and mechanical properties of treated and untreated nickel-containing iron are given for material cast in the form of 0.875-in. diameter test bars. The structure of the untreated bar is shown in Fig. 30 to consist of undercooled graphite in a matrix of austenite, together with a small amount of carbide.

The structure of the treated bar is illustrated in Fig. 31, and is seen to have nodular graphite in a matrix of austenite with rather more carbide than the untreated bar. The treated material was, in this case, produced by treatment of the melt with misch metal alone—the double treatment technique was not employed. It is apparent that the nodular nickel-containing iron has mechanical properties considerably in excess of those of the untreated material.

Example 7—With relatively high sulphur contents the yield of cerium depends upon the extent of the desulphurization produced by the addition. In such cases, if desulphurization by the cerium is allowed to take place, the yield of cerium will be low, but it is imperative for the success of the process that this desulphurization should occur.

If desulphurization by the cerium addition is not effected, the apparent yield of cerium will be high, but this cerium, as found by chemical analysis, will be largely combined with the sulphur and hence will not operate to produce nodular structures. As an instance of the desulphurizing influence of cerium, the figures in Table 10 may be quoted for the treatment of cupola-melted nickel-containing iron. These figures clearly indicate the importance of the cerium not combined with the sulphur in determining the graphite structure.

High Carbon and Low Sulphur

Example 8—The production of nodular cast irons by the process described in this paper presents no special metallurgical difficulties with batch-type melting units if high-carbon and low-sulphur charges are used. The material has been successfully produced in direct- and indirect-arc furnaces, high-frequency induction furnaces, crucible furnaces and oil-fired rotary furnaces

TABLE 6—MECHANICAL PROPERTIES OF 0.50 PER CENT PHOSPHORUS IRON

Bar Size, in.	Transverse Rupture Stress, psi	Deflection, in.	Tensile Strength, psi	BHN	Impact Strength, ft-lb
1.6	82,500	0.20	43,400	241	—
1.2	81,800	0.20	45,300	242	—
0.875	94,100	0.14	43,900	256	11
0.6	81,300	0.09	40,300	285	—

TABLE 7—HIGH MANGANESE NODULAR IRONS

No.	Composition per cent T.C.	Si	Mn	S	P	Ce	Tensile Strength, psi	BHN
1	3.63	2.91	2.01	0.009	0.044	0.067	72,800	256
2	3.51	3.00	2.92	0.017	0.034	0.057	81,100	319

TABLE 8—NICKEL-MANGANESE AUSTENITIC IRON

Bar Size, in.	Transverse Rupture Stress, psi	Deflection, in.	Tensile Strength, psi	BHN	Impact Strength, ft-lb
1.6	32,300	0.60	11,960	86.8	—
1.2	37,000	0.80	13,210	90.7	—
0.875	37,600	0.38	15,000	102	105
0.6	42,100	0.32	16,350	102	—
Untreated: T.C., 3.28; Si, 3.08; Mn, 5.8; S, 0.022; P, 0.072; Ni, 11.87 per cent					
1.6	103,600	1.75	39,000	158	—
1.2	105,300	>2	37,400	156	—
0.875	106,100	1.60	36,700	172	120
0.6	93,200	0.65	35,800	174	—
Treated: T.C., 3.03; Si, 3.18; Mn, 5.9; S, 0.018; P, 0.053; Ni, 12.93; Ce, 0.023 per cent					

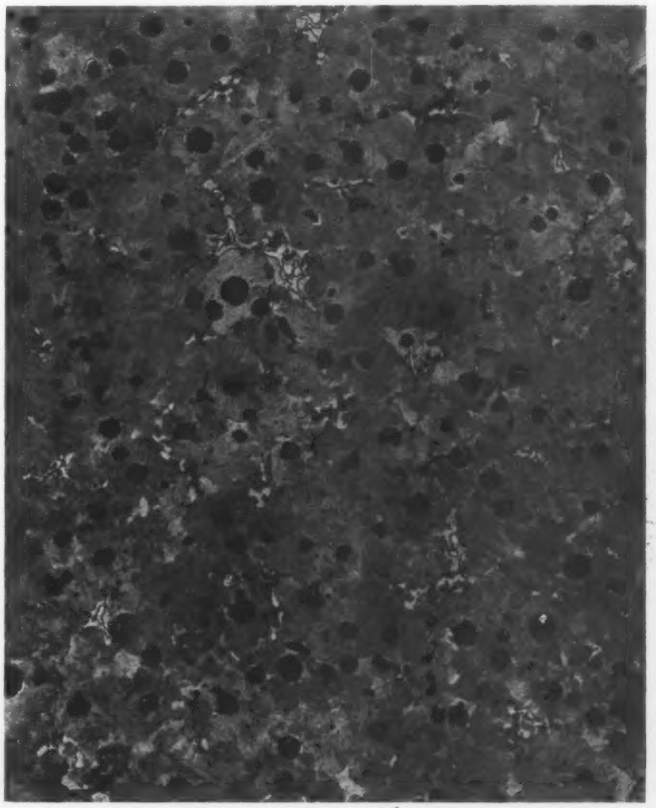


Fig. 29—Microstructure of 1.2-in. bar (No. 2, Table 7) produced in double-treated nodular iron with 2.92 per cent Mn content. Etched in picric acid. ×100.

Table 9—Mechanical Properties of Nickel-Containing Iron

	Composition, per cent								
	T.C.	Si	Mn	S	P	Cr	Cu	Ni	Ce
Untreated	2.76	2.68	0.45	0.027	0.024	1.74	6.74	13.24	—
Treated	—	—	—	0.007	—	—	—	—	0.045

	Transverse Rupture Stress, psi	Deflection, in.	Tensile Strength, psi	BHN
Untreated	65,300	0.47	27,300	146
Treated	106,500	0.86	46,100	185

Table 10—Desulphurizing Influence of Cerium

Addition of Ce as Misch metal, per cent	S, per cent	Ce (by Analysis), per cent	Structure
0.1	0.099	0.066	Flake graphite
0.2	0.051	0.071	Flake graphite
0.3	0.014	0.063	Nodular graphite

Table 11—Mechanical Properties of Cupola-Melted Cast Iron Desulphurized With Sodium Carbonate

Composition: T.C., 3.69; Si, 2.77; Mn, 0.63; S, 0.005; P, 0.045; Ce, 0.057 per cent

Test Bar Diameter, in.	Transverse Rupture Stress, psi	Deflection, in.	Tensile Strength, psi	BHN
3.0	106,000	0.51	85,000	241
2.1	142,700	2.14	——	——
1.6	152,000	1.30	——	——
1.2	137,500	0.95	80,400	218
0.875	174,300	0.83	76,500	244
0.6	179,500	0.53	——	——

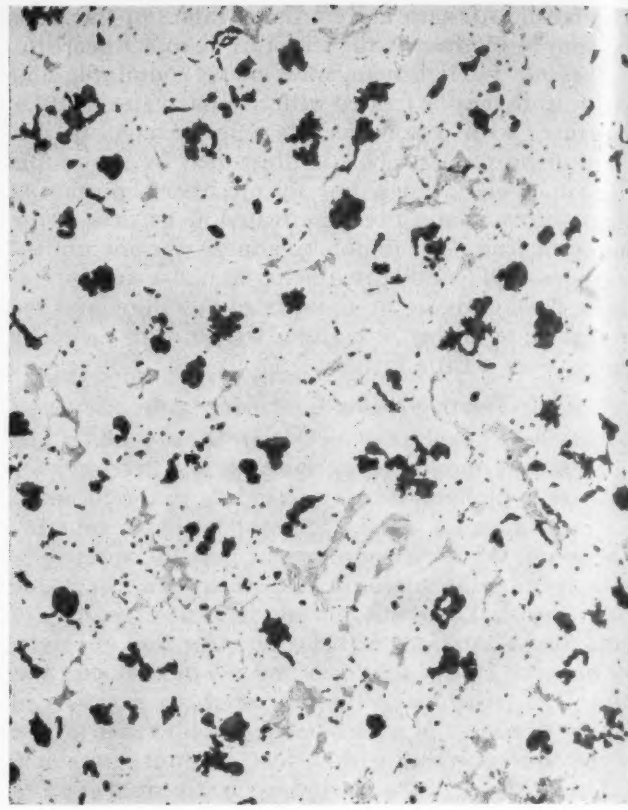


Fig. 31—Microstructure of 0.875-in. bar in nodular nickel-containing iron (Table 9). Picric etch. ×100.

by melting low sulphur (of the order of 0.03 per cent sulphur) hematite pig iron and making the appropriate additions of cerium in the ladle.

With the cupola melting furnace the production of molten iron suitable for the application of this process becomes more difficult and, in general, special precautions need to be taken to ensure that the metal is of the correct composition. The production of high-carbon or hypereutectic cast irons from the cupola is not a difficult matter provided the average carbon content of the charge is reasonably high.

It is, however, contrary to normal practice to aim to produce high-carbon material for the purpose of making a high-duty cast iron. For many years the trend has been in the direction of obtaining lower rather than higher carbon contents.

Desulphurizing in the Ladle

Production of satisfactory low-sulphur contents presents much more difficulty. Even when low-sulphur charges are used there generally is a sulphur pick-up from the coke and the sulphur content of the metal tapped will be too high to allow immediate treatment with misch metal, and it therefore becomes necessary to interpose a preliminary desulphurizing treatment of the metal in the ladle.

If the sulphur content of the metal tapped from the cupola is within the range of 0.05-0.08 per cent, it is possible to desulphurize the metal to a satisfactory low-sulphur content by one treatment with sodium carbo-

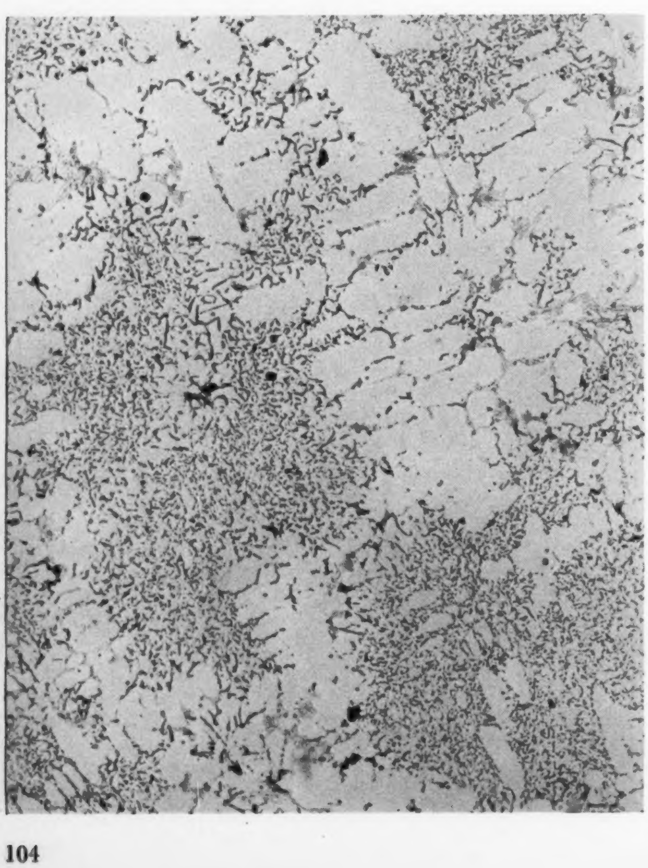


Fig. 30—Structure of 0.875-in. bar in untreated nickel-containing iron (Table 9). Picric acid etch. ×100.

nate, preferably using a ladle lined with a basic refractory. With sulphur contents in excess of 0.08 per cent the "double ladle" technique of desulphurizing may have to be applied.

Nodular cast irons can be produced from the cupola, using the sodium carbonate desulphurizer prior to the addition of the misch metal. The mechanical properties given in Table 11 illustrate the results which have been obtained from a cupola operating under industrial conditions. These results were obtained from test bars cast from a cupola run in which the metal was tapped directly onto sodium carbonate placed in the bottom of the ladle, the slag thickened with limestone and skimmed off, and then misch metal and silicon-manganese-zirconium added. The microstructure of all bars of this set had spherulitic nodular graphite. The structure of the 1.2-in. bar is shown in Fig. 32.

Summary and Conclusions

Production of nodular graphite structures by the process described in this paper represents a new development in the field of the metallurgy of cast iron. The past two decades have witnessed the gradual evolution of high-duty gray cast iron, particularly in the field of castings for the engineering and automobile industries. This evolution began with the realization of the importance of the control of carbon and silicon and the relative adjustment of these two elements in cast iron. This phase was accompanied by the development and application of the hot-mold process and the utilization of high-steel mixtures in cupola practice.

Next, the inoculation technique was introduced and developed to a process of indispensable commercial utility. The aim of this technique has been to give random flake graphite structures in irons of relatively low carbon and silicon contents and to inhibit and control the chilling tendencies of such irons. All of these developments have been accompanied by advances in the use of special alloying elements, such as chromium, nickel, copper, molybdenum, etc., to strengthen the metallic matrix of cast iron.

These advances have culminated in the production of the nickel-molybdenum acicular cast irons which, in commercial production, represent a combination of most of the earlier developments—acicular irons are essentially irons with controlled low carbon contents; they are usually inoculated and have a combination of alloying elements which, after an appropriate heat-treatment, confer the maximum strengthening effect on the metallic matrix.

At this point it was reasonable to enquire in what direction further developments in cast iron metallurgy were likely to lead. For practical foundry reasons there appeared to be a lower limit to the carbon content of cast iron used under general production conditions. The inoculation technique had been developed to a state of precise control and no immediate hope could be held out that new elements or combinations of elements could easily raise the strength of the metallic matrix beyond that already achieved (this latter is, however, a field which must be continuously and painstakingly explored).

At this formidable barrier it is to be expected that attention should be focused on the possibility of producing nodular graphite structures in cast irons without the necessity for a heat-treatment application.

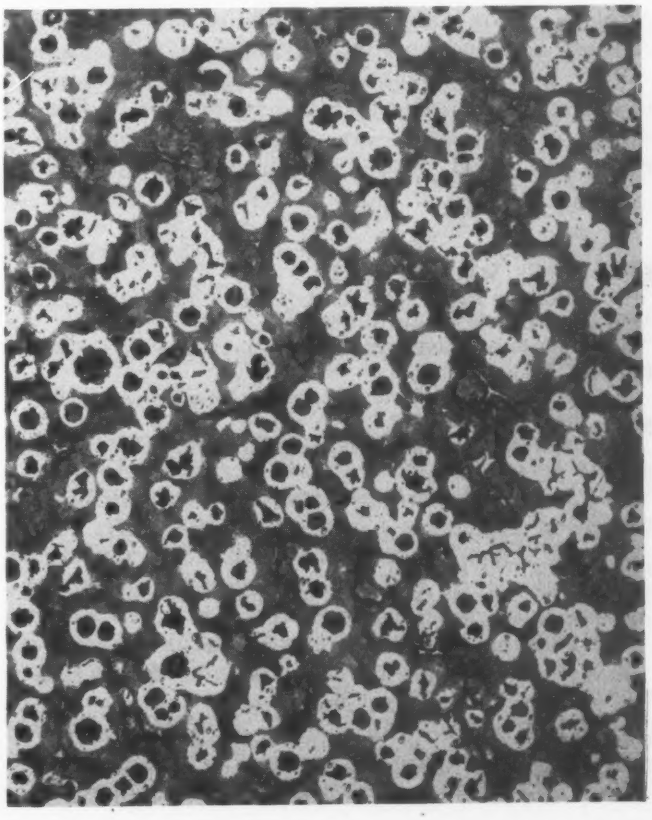
In the opinion of the author it can now be claimed that this development, once seemingly remote, has now been demonstrated to be a possibility and, furthermore, that a process has been developed which is capable of application on an industrial scale. Nodular cast irons produced by the process described in this paper can be readily recognized and differentiated from ordinary gray or malleable cast irons.

Nodular graphite structures are usually associated with malleable cast iron, but it should not be assumed that the properties of the nodular cast irons described in this paper in any way resemble those of malleable irons. The nodular irons represent a material which lies midway between a normal high-duty gray cast iron, on the one hand, and malleable cast iron on the other. Nodular cast irons still are relatively non-ductile and brittle, although they may have a shock-resistance many times better than that of normal gray cast irons.

In this paper it has been shown that the graphite nodules in nodular cast irons are of the spherulitic variety. In studying features of this type erroneous conclusions may be reached unless the metallographic aspect of the work is conducted with great care. The present author and his colleagues have discussed the formation of graphite spherulites more fully on previous occasions, references to which have been given.

The spherulitic form of graphite nodule is probably more commonly known in Europe than in the United States because the manufacture of whiteheart malleable iron is mainly conducted in Europe. Nevertheless, the author would like to draw attention to this interesting form of graphite crystallization which forms the

Fig. 32—Microstructure of 1.2-in. bar (Table 11) in cupola-melted double-treated iron, shows spherulitic nodular graphite. Etched in picric acid. ×60.



nucleus upon which the present process for the production of nodular graphite in cast irons has been built.

Also in this paper a new graphite arrangement has been recognized and described as "quasi-flake graphite." This form of graphite does not weaken the iron to the same extent as ordinary flake graphite, and may itself be an important structural constituent in some nodular irons.

No attempt has been made to deal with the heat-treatment or with the special mechanical properties of nodular cast irons. These will form the subject of future papers . Nevertheless, it can be stated that nodular irons can be subjected to all the usual forms of heat-treatment, without influencing the graphite structure, for the purpose of obtaining special effects. Nodular cast irons may also be alloyed with elements such as chromium, nickel, copper, molybdenum, etc., to obtain special strength effects in the metallic matrix.

Nodular cast irons may be run and cast in a variety of sections, but problems relating to porosity and fluidity are no greater than those inherent in the production of normal gray cast iron.

It is impossible at this stage to predict the future of nodular cast iron, but the possibility exists of the material playing an important part in the field of engineering and related applications where high strengths are required, and redesign to take advantage of these strengths maybe an important factor in the economy of nodular cast irons. The field has now been revealed and other and more convenient processes may be developed to achieve the same end, but it is fairly safe to assume that any alternative process will still demand a high degree of technical skill and control in the producing iron founder.

Acknowledgments

The author wishes to thank the Council and Director, J. G. Pearce, of the British Cast Iron Research Association, for permission to publish this paper. In addition he is indebted to his co-workers, J. W. Grant and W. J. Williams, for their enthusiastic co-operation in much of the work which is described, to W. Westwood and A. Mayer of the association's chemical laboratory, and to D. Marles, metallographic laboratory.

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Britain's National Foundry College Provides for Training and Research

National Foundry College, successor to the prewar British Foundry School started in 1935, opened January 5 at Wolverhampton.

The college is housed in, and will work in conjunction with the Wolverhampton and Staffordshire Technical College. Sponsored by the Ministry of Education, the College provides national facilities for foundry education and research. Full-time, part-time and refresher courses are offered; the curriculum covers the whole of the foundry industry. The school's Diploma Course will run for an academic year of 40 weeks from September to July.

There is no upper age limits for admission, and the standard of practical experience and technical knowledge of applicants must satisfy the Board of Governors that they are in a position to profit from the instruction. A minimum of one year's practical experience in at least one branch of the industry is required, together with either a university degree, preferably in metallurgy or engineering, or membership in a professional society. Nationally-known foundry experts will be invited to participate in the work of the College.

National Foundry College provides the finest possible training for men wishing to qualify for positions of highest responsibility, and serves as a refresher course for foundry executives anxious to keep pace with recent industrial achievements in England and abroad.

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GATING SYSTEM DESIGNS AFFECT POURING RATES

J. G. Mezoff
and
H. E. Elliott

SELECTION OF THE PROPER POURING RATE for a given casting is important. Many quality factors may be adversely affected by the choice of a pouring rate which is either too fast or too slow. No less important than the selection of the proper pouring rate is the control of the rate for all molds made from the same pattern.

Work described in this paper was undertaken in an attempt to determine which factors of gating system design importantly affect the pouring rates of castings. Although the work was conducted using magnesium alloys, many principles were established which are applicable to any casting alloy. Since in practice most foundrymen control the pouring rate at the sprue, the present work centered attention chiefly on the effect of sprue and pouring cup design, although other foundry variables were also investigated.

Experimental Work

In planning the work, the pattern described in Fig. 1 was designed. It consisted of a series of interchangeable sprues (*A*), a basin (*B*) which holds about 30 lb of AZ63 alloy (Al, 6; Zn, 3; Mn, 0.2 percent; remainder, Mg), a 4-in. diameter vent (*C*), and a boss (*D*). The sprue was molded in a position directly over the basin so that a gate or runner was not required. In this way the sprue itself controlled the pouring rate. A fabricated steel pouring basin, 5 in. deep and 10 x 5 in. in horizontal section was used. The sprue was located near one end of the basin.

For accurate timing an operation time recorder was used. Copper wires with high-temperature insulation were connected to the recorder. The other ends of the wires were rammed-up in the mold in such a way that they were flush with the surface of the casting cavity, thus forming a point contact with the metal when it reached that position in the mold. In this way one contact was placed in the pouring basin, and the other in the boss on the casting cavity. The elapsed time between the moment the metal entered the pouring basin and the moment the casting cavity filled completely was measured. The pouring rate was calculated, using weight of complete casting minus that of vent.

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The function of the vent was to minimize the "water-hammer" effect which tends to raise the cope of an unrisered mold. The lower contact was placed in a boss to avoid a possible premature contact caused by turbulence of the metal surface as it rose in the basin.

In all cases, unsuperheated commercial AZ63 alloy was used. This was melted in steel crucibles under crucible-type flux. Unless otherwise specified, the sprue length (cope height) in all cases was 12-in. and the pouring temperature 1400 F.

Reproducibility of Pouring Rates

All of the data gathered in these studies are presented in graphical form. It was not considered necessary to present the voluminous data in tabular form; instead, the typical spread of values is indicated by plotting each test made as a single point (Figs. 2, 3, 4, 5, 6, 7 and 8). In all other graphs each point represents the average of data from at least three and in cases as many as 15 tests. In such cases, the spread of values obtained is not indicated.

A wide spread of values was observed in most of the test results. Under the best controls achieved, reproducibility of a result was only fair from one test to another. It is considered that the most likely cause of poor reproducibility lies in the pouring practice by which the metal is transferred from the crucible to the sprue. Pouring into one end of a rectangular pouring basin gives rise to considerable visible turbulence, especially at the beginning of the pour. Then too, it is difficult to duplicate exactly the effectiveness with which the pouring basin is flooded with metal at the beginning of a pour. Especially at the more rapid pouring rates were these problems troublesome. A

Since one of the factors importantly affecting the quality of castings is their pouring rate, this work was undertaken to determine which factors of gating system design control the pouring rates of castings. While magnesium alloys were used in conducting the tests, many of the principles which were established would apply to the casting of any metal. The effects on pouring rate of the following design factors were established: Sprue cross-sectional area, sprue cross-sectional shape, sprue length, sprue taper, sprue mouth design, and pouring basin depth. Also studied was the effect of pouring temperature. Results are in graphic form.

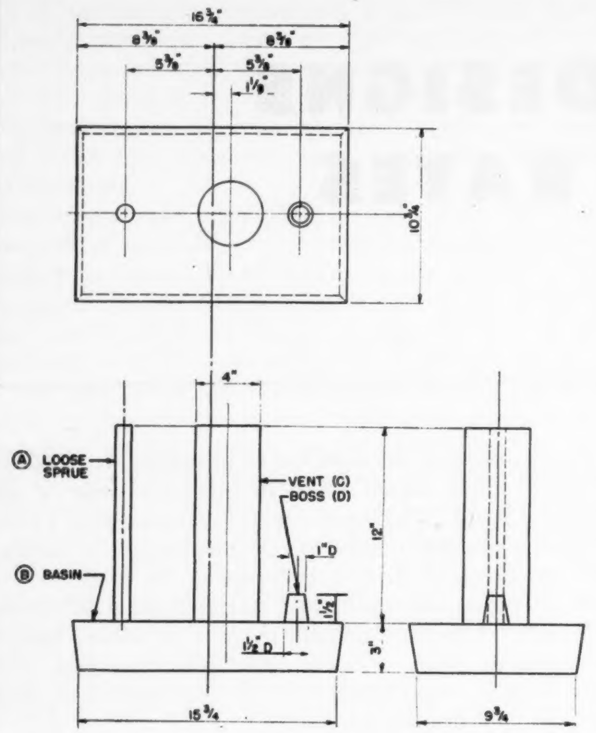


Fig. 1—Diagrammatic sketch of sprue test casting designed for testing pouring rates of sprues.

substantial part of the lack of reproducibility observed in these tests appears to be fundamentally a property of normal crucible pouring practice.

Effect of Sprue Cross-Sectional Area on Pouring Rate—The graph in Fig. 9 shows the effect of sprue cross-sectional area on the pouring rate of the test casting. These results were obtained using untapered sprues of various cross sections on the test casting, and measuring the resulting pouring rates. It is interesting to note that a straight-line relationship between sprue area and pouring rate, as has been suggested by the writers,[2] does not exist. As the sprue cross section increases, the area becomes less and less effective in delivering metal to the casting cavity. It is probable that the chief cause of this reduced effectiveness of area is the increased turbulence at the upper mouth of the sprue at the higher pouring rates. Another contributing factor may have been the greater difficulty with the larger sprue areas of flooding the pouring basin at the beginning of the pour.

It is also noticed in Fig. 9 that the round sprues poured faster than rectangular sprues of like cross-sectional area, and that slot sprues consisting of thin slots poured more slowly than those consisting of thick slots, total cross-sectional area being the same. In another paper [2] the authors have presented evidence that the restriction to flow offered by a round, untapered sprue is centered at its upper mouth, while with slot sprues, the sidewall resistance is also significant. It is apparent that, through some such mechanism, sprues having a large ratio of cross-sectional area to cross-sectional perimeter pour more rapidly than those having similar area but a lower ratio of area to perimeter. In Figs. 2 and 3 are plotted additional data showing

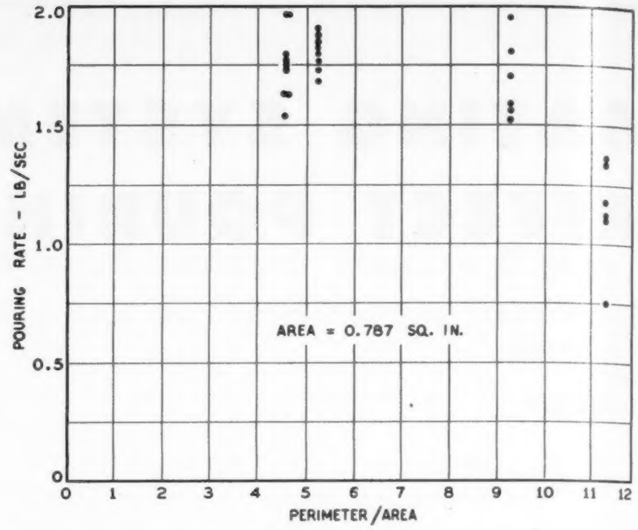


Fig. 2—Effect of perimeter/area ratio upon pouring rate of sprues having the same cross-sectional areas.

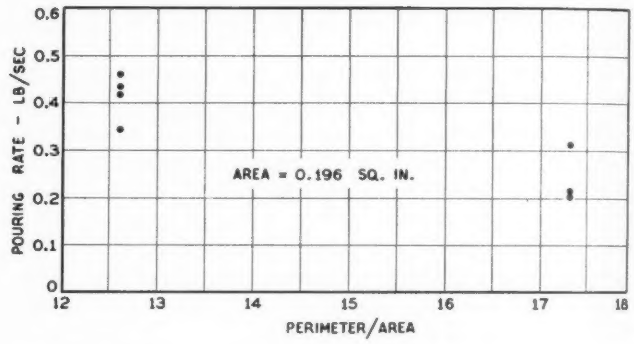


Fig. 3—Perimeter/area ratio effect upon pouring rate of sprues having the same cross-sectional areas.

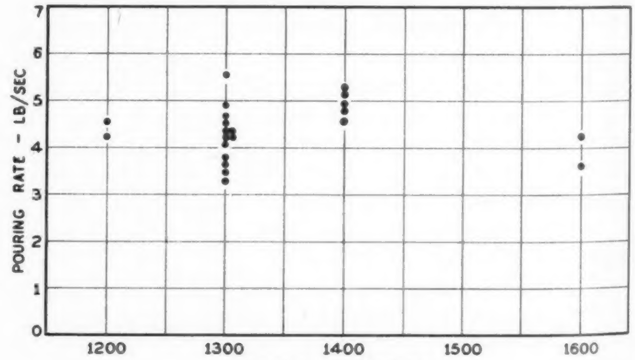
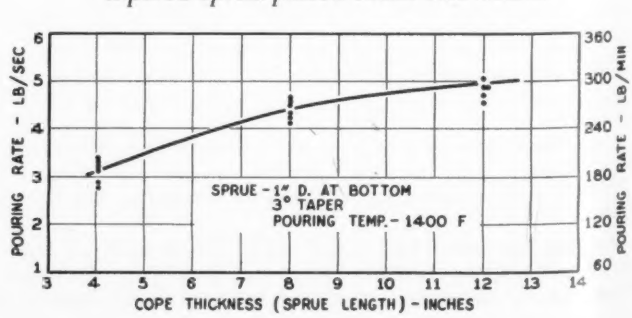


Fig. 4—Pouring temperature effect upon the pouring rates of sprues having diameters of 1½ in.

Fig. 5—Sprue length effect upon the pouring rate of a tapered sprue placed small end down.



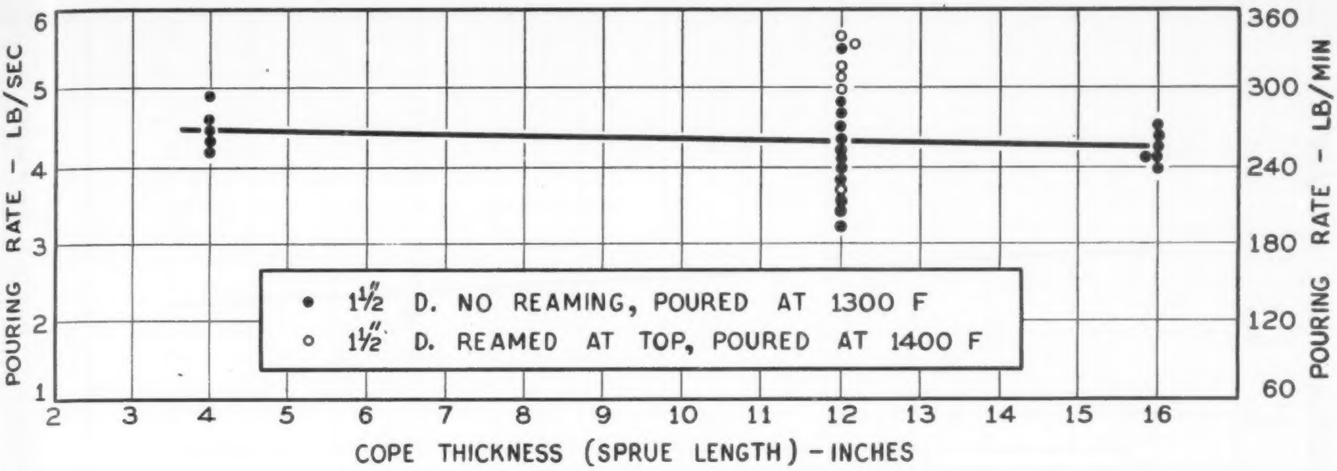


Fig. 6—Curve showing pouring rate of 1½ in. diameter sprue as affected by the length of the sprue.

the effect of this area to perimeter ratio on the pouring rate for sprues of equal cross-sectional areas.

Effect of Pouring Temperature on Pouring Rate—Figures 4, 10 and 11 show the relationship between pouring temperature and pouring rate of various sprues. Figure 10 again shows the effect of the ratio of sprue area to sprue perimeter on pouring rate. A temperature range of around 1400 F appeared to give the most rapid pouring rate for a given sprue. A considerably higher or lower pouring temperature usually resulted in a slower rate of pour. The effect of lower pouring temperatures may be one merely of lower fluidity of the liquid metal. The effect of the higher temperatures in retarding pouring rates may be caused by increased evolution of gases from the mold material and increased reaction of these gases with the metal to form oxides. The effect of retardation of pouring rate at high pouring temperature was particularly marked when slot sprues were used . The entrapment of gases in the sprue under these conditions has been noted by the authors in another paper.[2]

Sprue Length Effect Upon Pouring Rate—Figures 5, 6, 7, 8 and 12 show (1) that the length of untapered round sprues does not affect their pouring rates; (2) the length of sprues tapering from a larger circular cross section at the top to a smaller circular cross section at the bottom has pronounced effect on pouring rate; and (3) that the length of slot sprues has a small but significant effect on pouring rate. These relationships are understood by assuming the following premises: (1) the resistance to metal flow of an untapered round sprue is concentrated at the upper mouth; (2) the resistance to flow offered by a tapered round sprue is not concentrated at the upper mouth, but may be concentrated at the base if sufficient taper is present; and (3) the sidewall resistance to flow of a slot sprue is significant with respect to that offered at the sprue mouth. These same assumptions about sprues of various design were successful in explaining "aspiration" effects in other studies.[2]

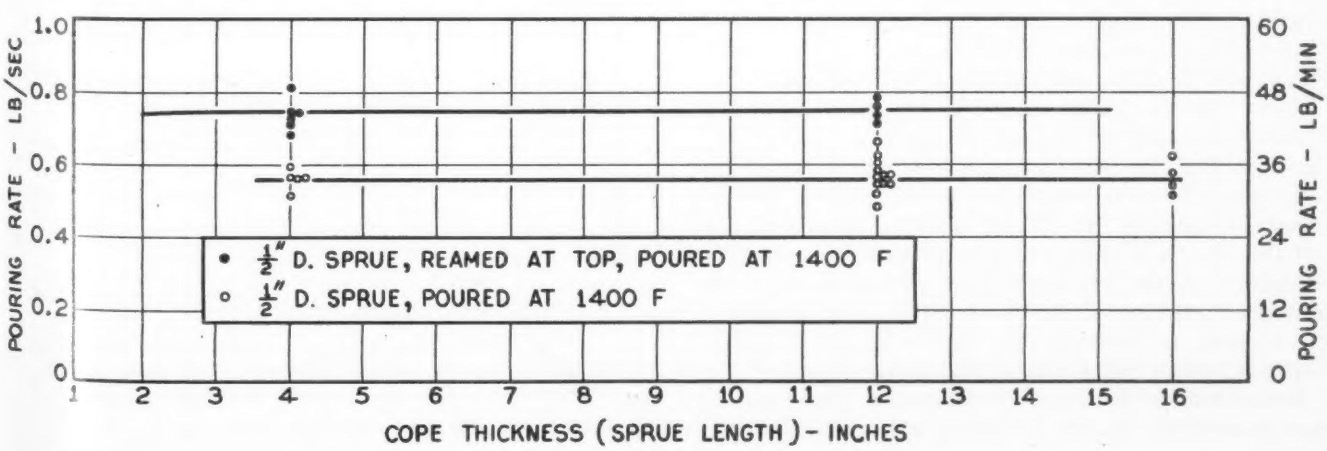
Resistance to Flow

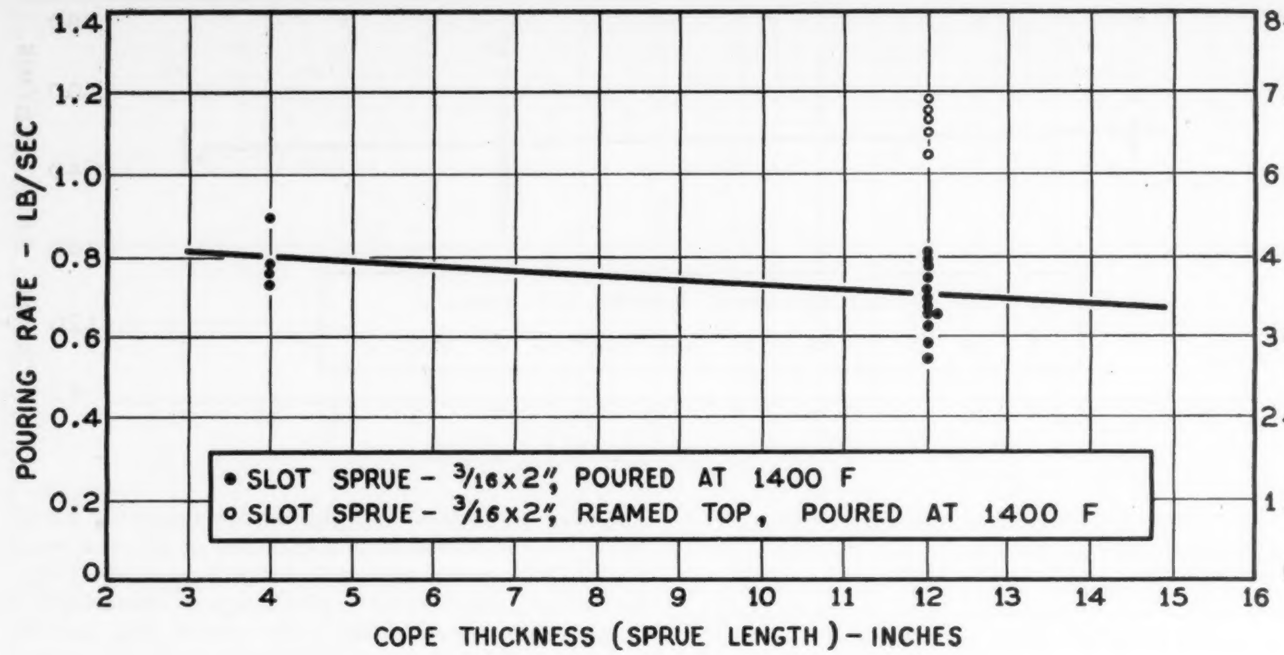
With untapered sprues, the only significant resistance to flow appears to be at the upper mouth of the sprue. Resistance to flow offered by the sidewalls seems to be of a lesser magnitude not significant with respect to that of the upper mouth. Hence, the total length of the sprue has no bearing on the rate at which an untapered round sprue will deliver metal.

When the ratio of cross-sectional perimeter to cross-sectional area is high, as with a slot sprue, the sidewall resistance to flow becomes significant with respect to that of the sprue mouth. Hence, the length of a slot sprue, as well as its cross section, influences its pouring rate.

With tapered round sprues, the total resistance to flow will be the sum of component resistances offered by the upper mouth, the sidewalls and the opening at

Fig. 7—Graph showing the effect of the sprue length on the pouring rate of small sprues.





the bottom. If only a slight taper is present, the upper mouth may offer the only significant resistance. If taper is extreme, the size of the opening at the bottom end of the sprue may be the only significant factor controlling the rate of pour. At intermediate degrees of taper, all three components may be significant. In any case in which other components than the upper sprue mouth resistance are significant, the sprue length will affect the pouring rate.

Influence of Metal Depth in Pouring Basin on Pouring Rate—Figure 13 shows the effect of the depth of metal in the pouring basin on rate of pouring. It is seen that for the round, untapered sprues tested the depth of metal in the pouring basin profoundly affects the pouring rate. This is easily understood when it is considered that for such sprues, the only significant restriction to flow is offered at the sprue mouth; and that, therefore, the height of metal over the sprue mouth in the pouring cup is the driving force controlling the flow rate. Benkoe [1] has assumed the pouring rate of sprues to be a function of the total length of the sprue plus the height of the pouring basin. The data herein presented indicated that only the depth of metal in the pouring cup affects the rate of flow where untapered sprues are involved.

For sprues tapered with the large end up, it is to be expected that the metal depth in the pouring basin would not have so great an effect, since the sprue length would also be a component of the head of metal, provided that there is sufficient taper to the sprue.

Spruce Mouth Design and Pouring Rate—Figures 6, 7 and 8 show the effect on pouring rate of "belling" the mouth of the sprue in such a way as to lower the resistance offered to metal flow at this point. The increase in pouring rate which resulted from reaming out the mouth of the sprue was greater than could be explained by the increased head of metal above the unreamed portion of the sprue. Therefore, a part of the increase in pouring rate had to be attributed to improved entry conditions at the sprue mouth.

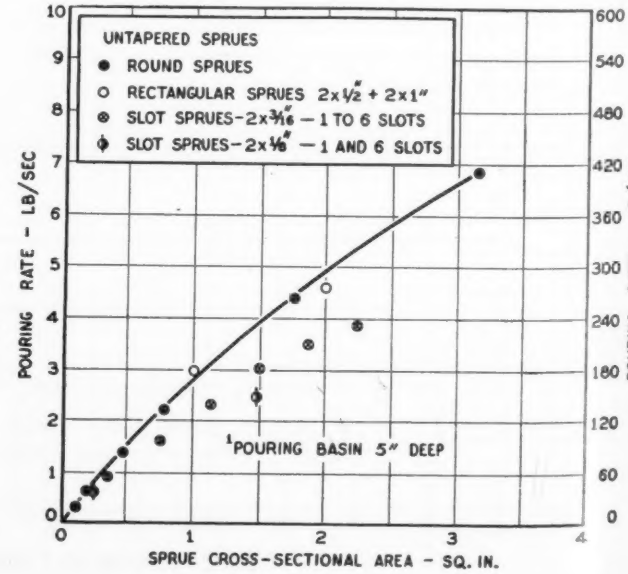
Relationships between sprue design and pouring rate established in the foregoing experimental work

Fig. 8—Plotted test points show effect of sprue height on the pouring rate of a slotted sprue.

provide a basis for varying the pouring rate of castings at will by several alternate methods; and by delineating those factors of sprue design which importantly affect pouring rate provide a basis for preventing large variations in pouring rate from one mold to another from the same pattern.

Considering first untapered sprues of circular cross section, the most obvious factor of design affecting their pouring rates is their cross-sectional area. In arriving at a suitable pouring rate for a given casting, the foundryman varies the diameter of the sprue until the desired pouring rate is attained. The other two factors affecting the pouring rate of the sprue are the depth of metal in the pouring cup and the design of

Fig. 9—Pouring rate at temperature of 1400 F influenced by cross-sectional area of the sprue.



the upper mouth of the sprue. The total length of an untapered round sprue has no effect on the rate at which it will deliver metal to the casting (assuming that the gating is so designed that the pouring rate is controlled at the sprue).

Pouring Rate Reproducibility

From these considerations, conclusions can be drawn as to which factors of sprue design must be most carefully controlled in order to secure maximum reproducibility of pouring rate from one casting to another. It would seem that three factors would be of first importance: (1) there should be a minimum of "rapping" of the sprue pattern to avoid variations in the effective sprue cross section; (2) the design of the upper mouth of the sprue should be as standard as possible from one mold to another; and (3) the pouring cup should be so chosen that it will be possible to control the depth of metal in it as closely as possible. More important than the absolute amount of variation in depth of metal in the pouring cup from one pour to another is the ratio between this absolute amount of variation and the total depth of the basin. The depth of metal in the basin is the "head" forcing metal to flow through the sprue mouth, and relative deviations in the amount of this head will produce corresponding relative deviations in the pouring rate.

It is to be mentioned that these relationships hold true only in the case of a permeable mold material. A round untapered sprue through an impermeable mold material might retain an unbroken column of metal in it throughout a pour due to the action of atmospheric pressure at the bottom of the sprue. If this happened, the total length of the sprue plus the depth of metal in the pouring basin would be the "head" tending to force the liquid through the sprue system.

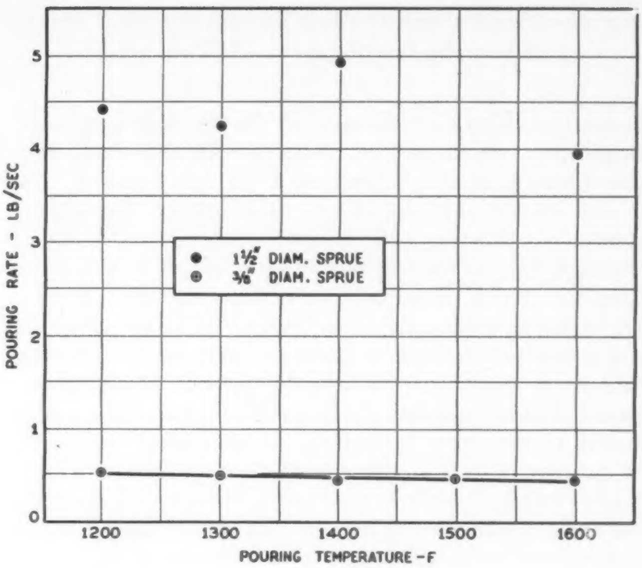
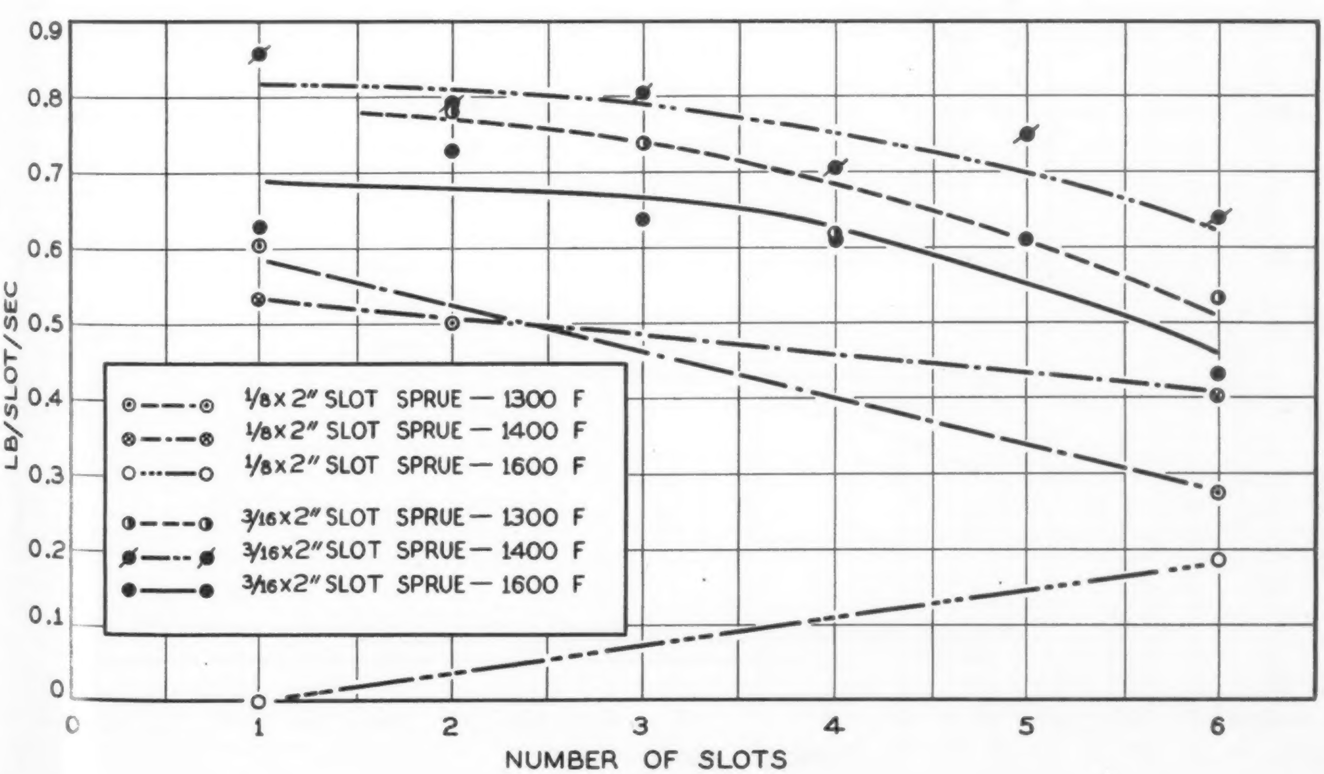


Fig. 11—Graph plotted to show the effect of pouring temperature upon the pouring rate of round sprues.

Neither do the same relationships appear to hold true in the case of tapered sprues with the small end down, nor with slot sprues. In both cases, the sprue length may be an important factor affecting the pouring rate of the sprue. Considering first tapered sprues, the degree of taper is of importance. If only a slight taper is imparted to the sprue, the upper mouth will remain the "bottleneck," and the sprue will behave exactly like an untapered one. As the degree of taper is increased, a point will be reached at which the size of the opening at the bottom of the sprue will become so small as to offer a significant resistance compared with that offered by the upper sprue mouth. At this

Fig. 10—Influence of pouring temperature and number of slots upon pouring rate of 3/16x2 in. slot sprues.



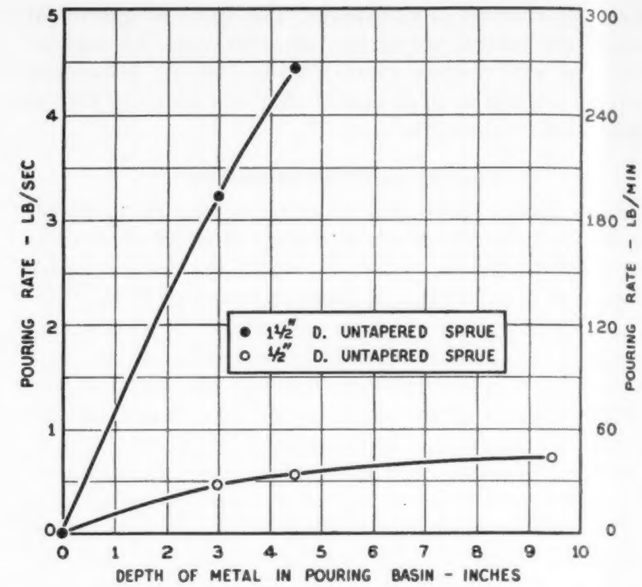


Fig. 13—Graph showing effect of pouring basin height upon pouring rate for sprue of 12-in. length.

point the sidewall resistance of the sprue may also be significant. As the degree of taper is further increased, the opening at the bottom will become so small that it will be the only significant resistance to flow in the system. At this stage, the "head" of metal forcing metal through this orifice will be the total length of the sprue plus the depth of metal in the pouring cup. Hence, for tapered sprues, the depth of metal in the pouring cup is unlikely to have as great an effect on the pouring rate as it does with untapered sprues. With sprues having a large amount of taper, the design of the upper mouth of the sprue is unlikely to be critical. It should be pointed out that the use of tapered sprues with a degree of taper sufficient to make the bottom opening the only significant source of flow resistance is likely to produce extremely large linear velocity of the metal through this orifice, and that due to this "spurting" such problems as turbulence with light metals or sandwash with heavier metals would tend to be aggravated. The optimum amount of taper for a round sprue would be that degree of taper at which both the sprue mouth and the bottom opening offer significant resistance to metal flow, thus preventing "aspiration" effects [2] and also excessive velocity at the sprue base. Unfortunately, quantitive work describing this optimum degree of taper for various sprue lengths and pouring rates has not been done at the present time.

Slot sprues also act somewhat differently from simple untapered round sprues. While the resistance to flow at the upper mouth of slot sprues is significant (see Fig. 8), it is indicated that the sidewall resistance is also a factor affecting the pouring rate . This is concluded from the fact that the sprue length appears to have a small effect on the pouring rate of slot sprues.

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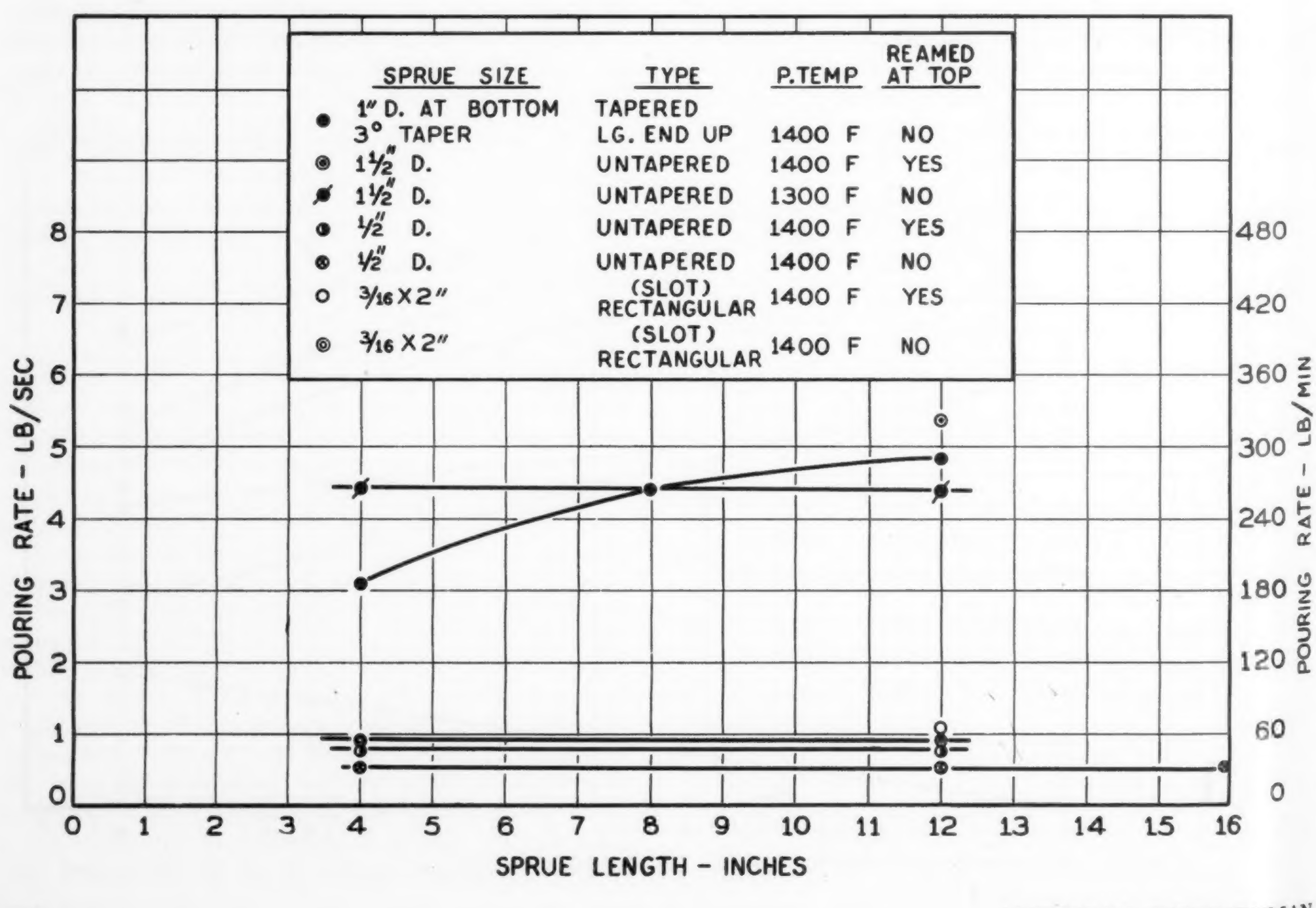
Fig. 12—Curves plotted to show effect on pouring rate of lengths of sprues of various sizes and types.



COPPER-LEAD ALLOYS

AUSTRALIAN EXCHANGE PAPER TO A. F. A.

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Melbourne
Australia

It is proposed to limit this paper to a discussion of those alloys of copper containing between 10 and 40 per cent lead, with or without small percentages of other elements such as tin, silver, nickel and phosphorus. The majority of the copper-lead alloys used in heavy-duty bearings fall into this category; however, such alloys find other applications such as slide valves, metallic packing, pump liners and seals for refrigeration compressors. As the term "leaded-bronze" should be applied strictly to those copper-lead alloys containing tin, the more general name "copper-lead" will be used in this paper.

Copper-lead alloys are reputed to be difficult to cast; however, many of the difficulties encountered would be eliminated if the facts revealed by a study of the copper-lead equilibrium diagram were clearly appreciated.

Binary Alloys of Copper and Lead

The copper-lead equilibrium diagram (Fig. 1) shows that copper and lead are mutually insoluble in the solid state, and that the solubility of copper in molten lead is not appreciable until a temperature of 900 C is reached. Alloys containing less than 36 per cent lead can become homogeneous liquids by heating above the line *CD* into Area 1. However, alloys containing more than 36 per cent lead lie within a "miscibility gap," that is, an area in which an emulsion of molten copper and lead is formed. This emulsion contains two liquid phases—copper-rich and lead-rich.

When a copper-lead alloy is slowly cooled from the completely molten state, the two metals will separate, forming a coarse mixture of the pure metals. Such an "alloy" would be of little use. However, when alloys containing less than 36 per cent lead are rapidly cooled from Area 1, globules of lead are trapped in the branches of the copper dendrites and at the grain boundaries of the copper-rich phase, thus producing a fine distribution of lead in copper. It is clear that the faster the rate of cooling, the finer will be the resultant structure, and the greater will be the improvement in mechanical properties.

Figure 2 (*A* and *B*) shows the structure in a 75 per cent copper, 25 per cent lead alloy after air cooling and after water quenching. The water-quenched alloy has a much finer lead distribution than the air-cooled alloy. The addition of 2 per cent tin alters the nature of the lead distribution but has no marked effect on the fineness of the structure of the alloy (Fig. 2 *C* and *D*).

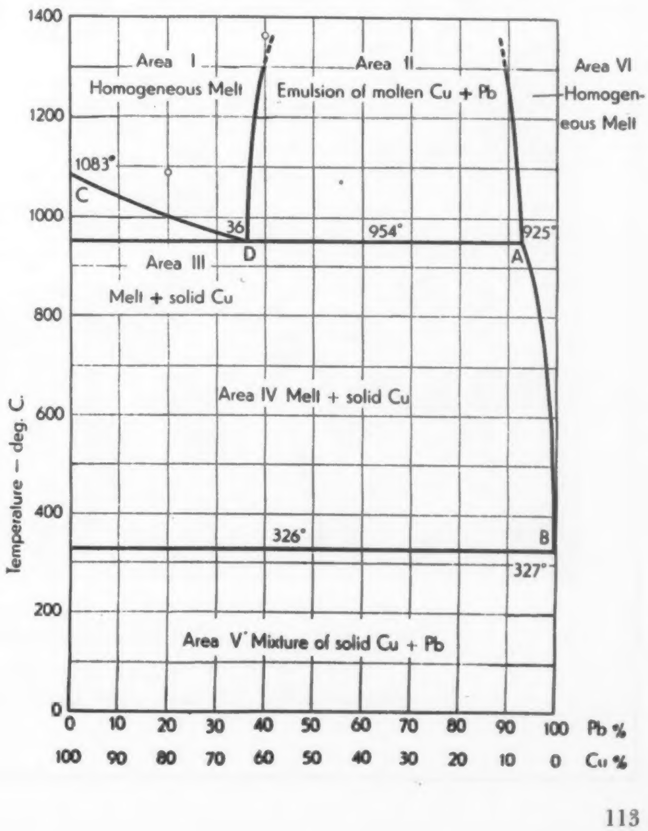
Alloys lying within the miscibility gap are still more difficult to cast satisfactorily, as the liquid alloy is not homogeneous but consists of an emulsion of molten lead in molten copper. The distribution of the lead can be improved by vigorous stirring, also by raising the temperature; however, the miscibility gap greatly increases the likelihood of lead segregation.

A. Effect on Equilibrium Diagram—Small percentages of many elements have a marked effect on the extent of the miscibility gap.[1] These elements fall into two classes:

1. Those which cause the miscibility gap to contract, e.g., silver, nickel and sulphur.
2. Those which cause the miscibility gap to widen, e.g., antimony, iron, tin and zinc.

Relative effects of the various elements can be seen in Fig. 3. Thus metals such as antimony and tin, by

Fig. 1—The copper-lead equilibrium diagram (Hansen).



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widening the miscibility gap, will increase the difficulty of dispersing a high percentage of lead in the copper-rich phase, whereas metals such as nickel and silver will facilitate the dispersion of lead by narrowing the miscibility gap.

B. Effect on Microstructure—The foregoing two classes of elements also have dissimilar effects on the microstructures of copper-lead alloys. The metallographic method used by the author and details of the metallography of copper-lead alloys have been described elsewhere.[3]

Both nickel and silver, when added to a copper-lead alloy even in small amounts (1 per cent), accentuate the semicontinuous network of the lead surrounding the copper dendrites. This type of structure is shown in Fig. 4 (*A* and *B*) which are sections of a copper-lead bearing, the first being parallel to the direction of growth of the copper dendrites on solidification, whereas the latter is at right angles.

Figure 4 thus emphasizes a fact often overlooked; namely, that the structure as seen in a polished specimen varies with the direction of the section as a result of the preferred direction in which solidification occurs. In the microexamination of bearings it is particularly important to remember this fact.

Addition of tin to copper-lead alloys results in a breaking up of the semicontinuous lead network to form a more or less globular distribution of the lead. As the tin content of the alloys is raised, the lead becomes increasingly globular in habit. When the tin content exceeds 8 per cent, the familiar alpha-delta constituent of copper-tin alloys appears and causes an increase in hardness. In general, the addition of tin to copper-lead alloys eliminates stringers of lead segregates which often occur when the lead is present as a network outlining the copper dendrites.

C. Effect on Dispersion of Lead—The effect of many metals on the segregation of lead in copper-lead alloys has been extensively studied. A summary of these investigations has been made by Bassett.[2] These results can be more or less systematized if it is remembered that the effect of an element on the miscibility

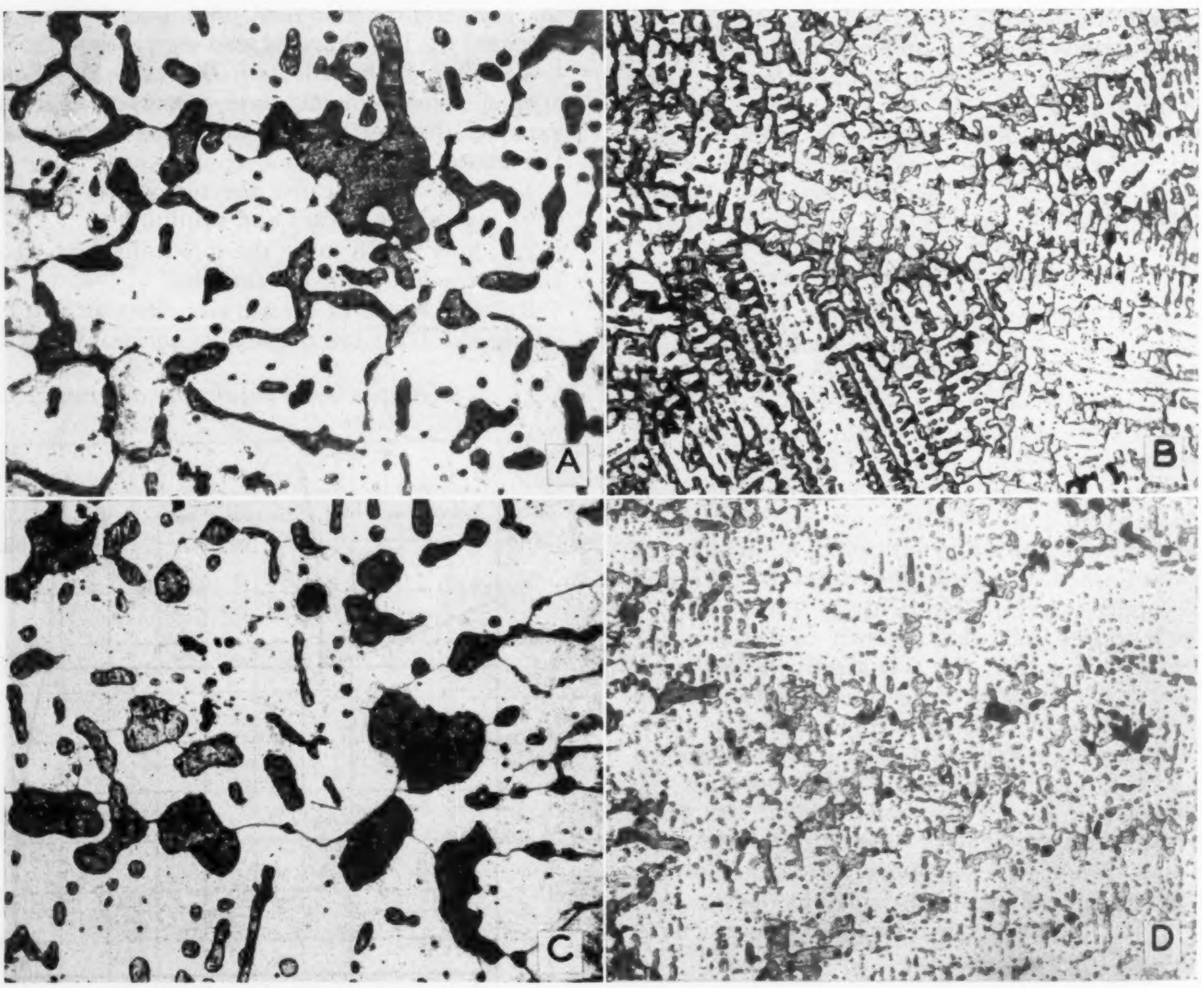

Fig. 2—Photomicrographs showing structures; A—copper-lead alloy (25 per cent lead) air cooled; B—copper-lead alloy (25 per cent lead) water quenched; C—copper-lead-tin alloy (25 per cent lead, 2 per cent tin) air cooled; D—copper-lead-tin alloy (25 per cent lead, 2 per cent tin) water quenched. × 150.

gap will determine to a large degree its influence on the solution of lead in copper. Tin is the most familiar example of these elements.

Although tin has a beneficial effect on the microstructure of the alloys, it limits the percentage of lead which can be taken into solution at high temperatures. Tin is typical of the metals which widen the miscibility gap. The higher the percentage of tin, the more limited will be the region over which miscibility is possible at high temperatures.

Tin Content—Casting Temperature

Some experiments were carried out [4] to determine the effect of casting temperature and tin content on the distribution of lead in a copper-lead alloy (25 per cent lead). Charges containing 0, 1, 4, 8 and 12 per cent tin, the remainder being 25 per cent lead plus copper, were put into small steel cylinders (6x2 in.) and placed in an electric furnace at constant temperature for 20 min. They were then withdrawn carefully without agitation and water quenched. The cylinders were sectioned and one half was polished in each case to determine the extent of solution of the lead. The results are summarized in Table 1.

Even at a temperature of 1300 C only partial solution of lead occurred when the tin content exceeded one per cent. In general, the higher the tin content the more difficult it was to bring the lead into solution. It should be emphasized that the conditions of the experiment compared unfavorably with practice as no attempt was made to stir or disturb the molten alloy in any way. However, similar results were obtained from chemical analyses of castings. Table 2 shows both the actual composition of the copper-rich portions of a series of castings and the nominal composition of the alloy charge. The divergence of the lead percentages at high tin contents is quite evident.

The following general conclusions can be drawn:

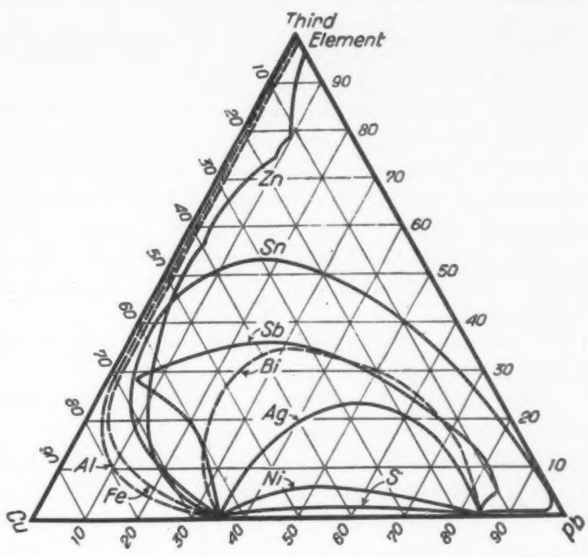

Fig. 3—Isothermal sections of ternary system of copper, lead, and a third element showing effect of various elements on the miscibility gap (Claus).

1. As the tin content of an alloy is increased, the temperature *prior to* pouring (not necessarily the pouring temperature) should also be increased.
2. Alloys containing high percentages of tin cannot be expected to retain a high percentage of lead as a *fine distribution* at room temperature.
3. Accurate temperature control is essential.
4. Agitation of the melt is desirable.

On the other hand, elements which tend to close the miscibility gap will promote the solution of lead in copper at high temperatures. High-lead alloys containing up to 30 per cent silver can be readily cast.

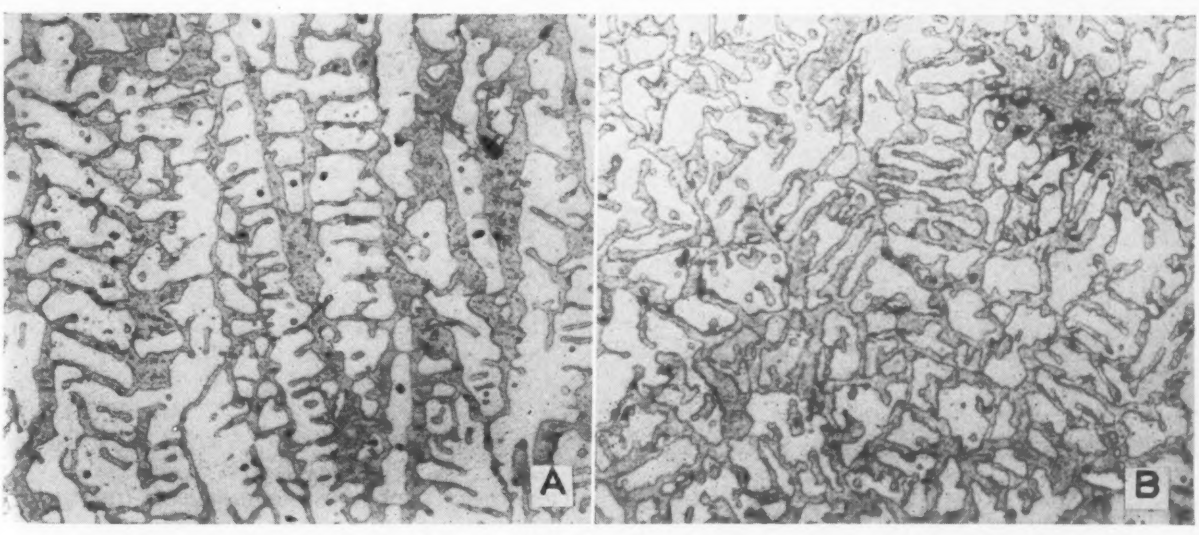

Fig. 4—Microstructures of an alloy containing approximately 25 per cent lead and 1 per cent silver: A—section parallel to direction of growth of copper dendrites; B—section at right angles to direction of growth of copper dendrites. × *250.*

With such alloys up to 50 per cent lead can be uniformly dispersed. Thus, if a very high lead content is required, a metal which narrows the miscibility gap, e.g., nickel or silver, should be added.

However, this means of producing a fine distribution of lead in copper has some disadvantages. First, the fine semicontinuous lead network produced has an adverse effect on the physical properties of the alloy, and second, microsegregation readily occurs. Lead tends to segregate between copper dendrites in the form of long stringers parallel to the direction of solidification.

It is thus obvious that there are two causes of lead segregation in copper-lead alloys:

1. "Macrosegregation" due to lead which is not dissolved in the molten copper at high temperature.
2. "Microsegregation" due to the coarseness of the lead precipitated from the copper on cooling. This may occur as isolated globules or as dendritic stringers.

It might be more accurate to define the segregation described in (1) as primary segregation of lead, because it occurs as a result of the lead not going completely into solution. Segregation of the second type could then be described as secondary segregation, i.e., segregation of lead precipitated from solution in copper on cooling.

It is thus not strictly accurate to say that an alloying element reduces segregation, for in reducing the amount of microsegregation it may quite well increase the amount of macrosegregation. Furthermore, it can only be said that an alloying element tends to reduce macrosegregation as variations in casting technique and cooling rate after casting may completely eliminate the defect.

D. Use of Deoxidants—It is general practice to use small percentages of certain elements such as phosphorus as deoxidants. Actually, addition of as little as 0.05 per cent phosphorus is ample to efficiently deoxidize copper lead alloys, although much higher percentages of phosphorus often are recommended on the

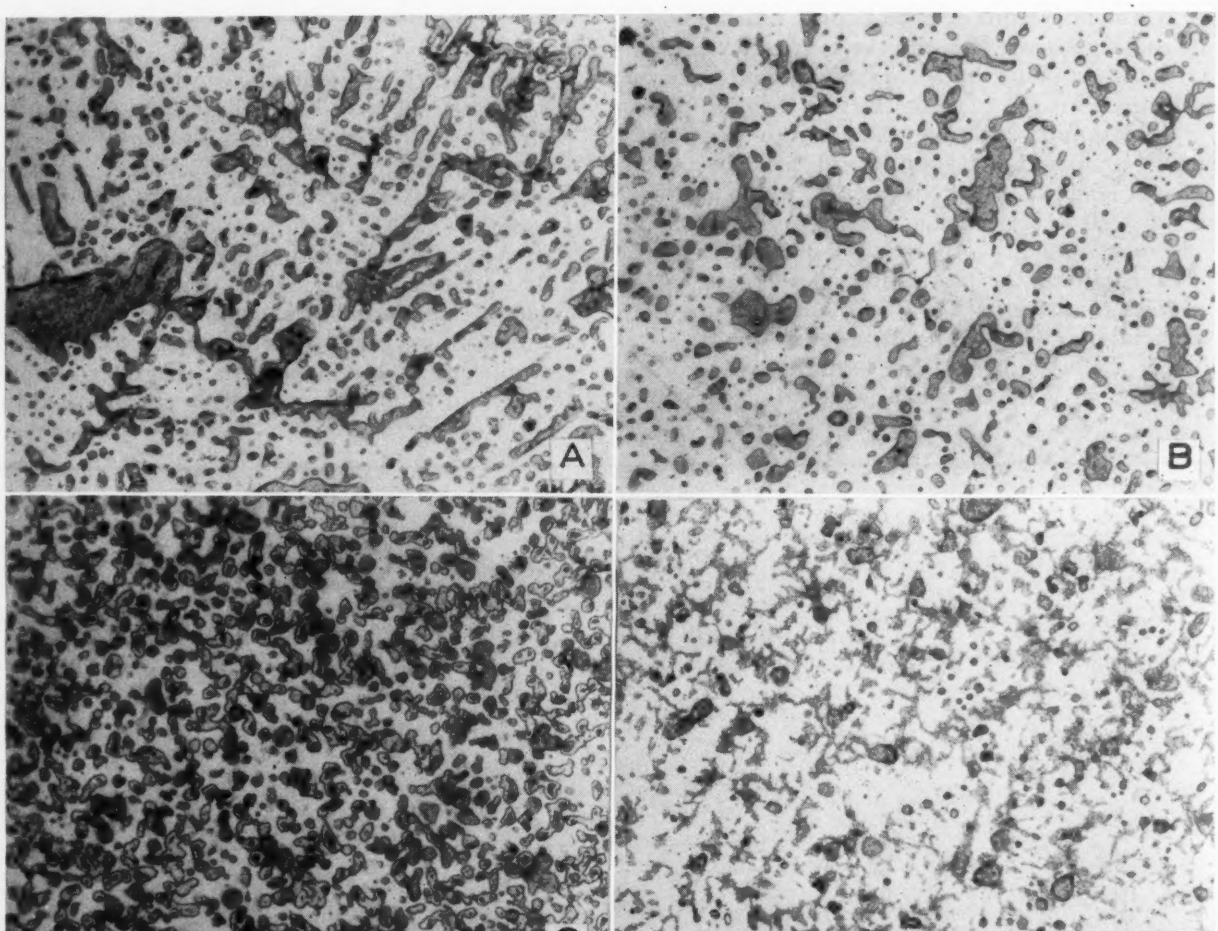

Fig. 5—Microstructures of copper-lead alloys containing increasing percentages of tin. A—0.8 per cent tin. The inter-dendritic lead network is partly broken up. B—4.0 per cent tin. Lead is present as discrete globules. C—9.0 per cent tin. Lead occurs as small globules. The copper-rich solution is cored and a small amount of the alpha-delta eutectoid is present. D—15 per cent tin. There is only a small percentage of lead present as small globules. Alpha-delta eutectoid has greatly increased. ×250.

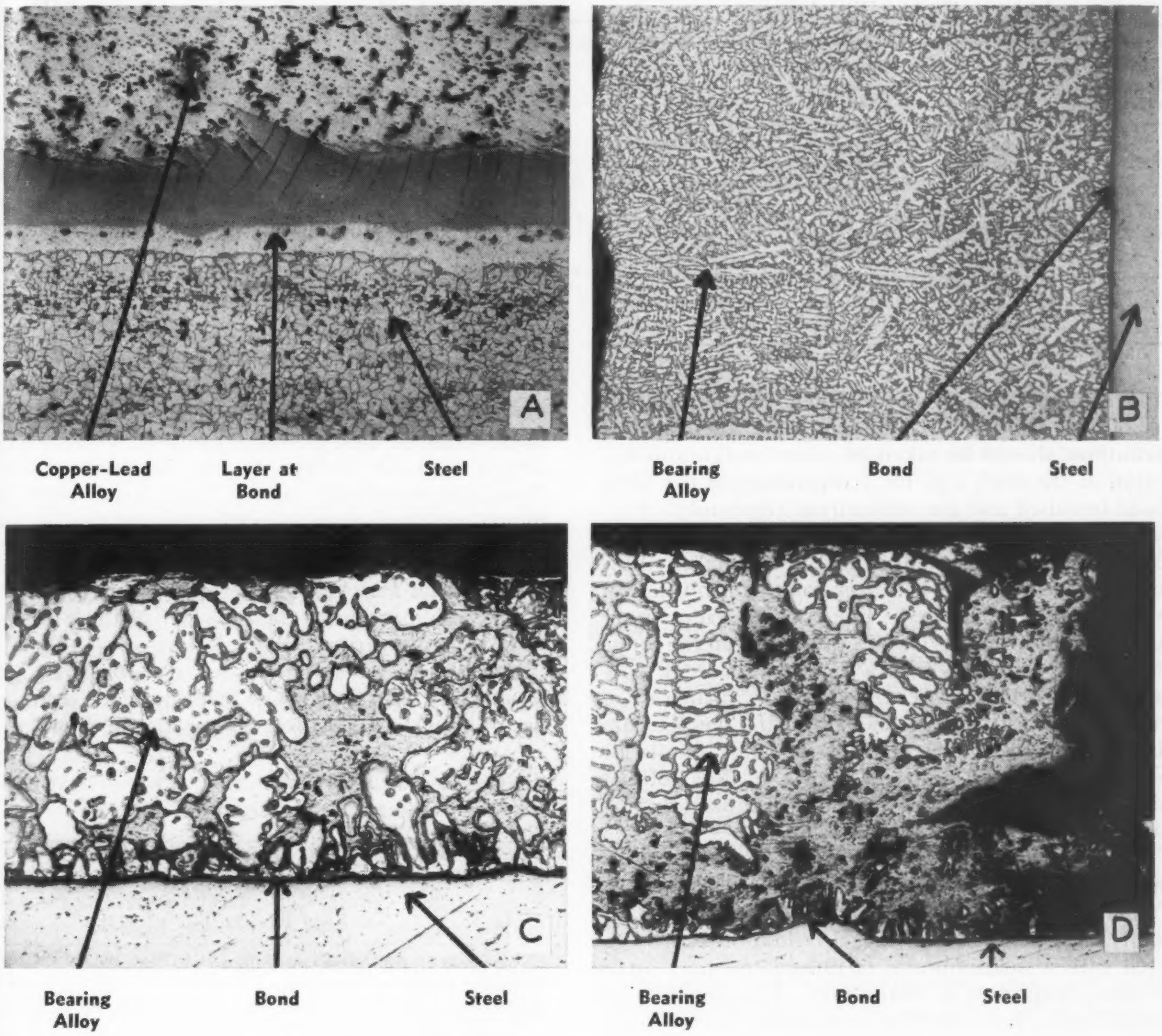

Fig. 6—A—Bond between steel and a copper-lead alloy containing 0.55 per cent phosphorus showing the formation of a thick brittle layer (tapered section). ×50. B—Cross section of a typical copper-lead aircraft engine bearing. The lead is present as a fine semicontinuous network. ×75. C—Cross section of a copper-lead bearing showing marked lead segregation. ×75. D—Failure of a copper-lead bearing showed marked lead segregation. ×75.

grounds that lead segregation is minimized and a finer structure obtained. It is the firm opinion of the author that high percentages (i.e., 0.1 to 1 per cent) of phosphorus should be avoided. Lead segregation can be eliminated and a suitable structure obtained without the need to resort to large additions of phosphorus.

Even small quantities have a very detrimental effect on the thermal and electrical conductivities of copper-lead alloys, a fact which should severely limit the use of phosphorus in alloys to be used for bearings where high thermal conductivity is a desirable property. The presence of more than 0.2 per cent of phosphorus is particularly undesirable if the alloy is to be bonded to a steel backing, as in car and airplane main bearings.

It has been shown [5] that the bonding of the copper-lead alloy may be unsatisfactory if the phosphorus content of the alloy approaches 0.5 per cent. The bond is rendered weak and brittle because of the formation of a phosphorus-rich layer on the surface of the steel. This layer can be clearly seen under the microscope (Fig. 6 *A*) and adversely affects bonding test results.

In the light of the foregoing it is possible to formulate some general rules to apply to the casting of copper-lead alloys. During melting it is essential to ensure the complete solution of the lead in the copper. To accomplish complete solution the alloy must be heated to a high temperature, 1200-1300 C, although not necessarily poured from this temperature range. The maximum temperature (to which the alloy is raised) during the melting should depend on: (a) the alloying elements present; and (b) the lead content.

In melting alloys containing high percentages of tin and lead, it is advisable to heat to 1250-1300 C prior to pouring, whereas in alloys containing silver, it need

TABLE 1—EFFECT OF TEMPERATURE ON SOLUTION OF LEAD IN COPPER-TIN ALLOYS

Alloy Composition, per cent Tin	Temperature of Alloy 1100 C	1200 C	1300 C
0	Lead partially in solution	Practically all lead in solution	Complete solution
1	Lead partially in solution	Partial solution	Practically complete solution
4	Much lead undissolved	Much lead undissolved	Partial solution of lead
8	Most lead undissolved	Much lead undissolved	Partial solution of lead
12	Most lead undissolved	Most lead undissolved	Partial solution of lead

not be necessary to heat above 1150 C. If the lead content of the alloy exceeds 30 per cent, then special precautions should be taken to ensure maximum dispersion of the lead, e.g., the temperature of the alloy should be raised and the melt stirred vigorously.

Temperature of pouring is not necessarily the maximum temperature reached; in fact, it is usual to allow the alloy to cool somewhat after complete solution of the lead has been achieved. The pouring temperature chosen should be above 1100 C, preferably in the range 1150-1250 C, for alloys with a high lead content. Unless the alloy is to be water quenched, as in the case of some bearing castings, the lowest pouring temperature compatible with homogeneity of the alloy should be chosen as it is very desirable that the alloy solidify quickly. The slower the rate of solidification, the coarser will be the lead distribution.

The molten alloy should be oxidized vigorously by removing the crucible lid and allowing a blast of air to pass over the molten metal for a minute or so. Finally, just prior to pouring, deoxidation can be effected with a small amount of phosphor-copper (0.05 per cent phosphorus in final alloy). This deoxidation with phosphor is not absolutely necessary, but it usually is safer to use it.

Alloying Elements—Effect on Physical Properties

Microstructures of copper-lead alloys have an important bearing on their physical properties. Those alloys in which the lead is present as a semicontinuous network will obviously have much poorer mechanical properties than the alloys in which the lead is present as discrete globules. Thus a copper-lead alloy containing 25 per cent lead and one per cent silver has much lower tensile strength and hardness than an alloy containing 25 per cent lead and 2 per cent tin. Table 3 shows the hardness and tensile strengths of three different copper-lead alloys which were cast and water quenched in the same way as are many bearing castings, thus producing a fine structure.

TABLE 2—ANALYSIS OF A TYPICAL SERIES OF COPPER-LEAD-TIN ALLOYS

	Alloy No. 1	2	3	4	5	6	7
	Actual Composition, per cent						
Copper	74.7	74.1	74.2	74.1	71.6	74.3	73.2
Lead	24.6	25.0	24.6	23.4	24.1	16.4	11.5
Tin	0.31	0.48	0.83	2.1	4.1	9.3	15.0
	Nominal Composition, per cent						
Copper	74.75	74.5	74.0	73.0	71.0	67.0	63.0
Lead	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Tin	0.25	0.50	1.0	2.0	4.0	8.0	12.0

The effect of increasing tin content on a series of copper-lead alloys containing nominally 25 per cent lead is to steadily increase the hardness. On the other hand, the addition of small percentages (2-3 per cent) of silver to a copper-lead alloy results in little change in hardness.

Thermal properties of the alloys are important in bearing applications where the rapid conduction of heat from the bearing surface is important. In copper-lead alloys the copper-rich phase is a good conductor; however, its thermal conductivity is markedly reduced by small quantities of certain elements,[1] of which phosphorus has the most pronounced effect. Other elements which markedly change the thermal conductivity are iron, nickel and tin. On the other hand, silver has a much smaller influence on the thermal properties.

Copper-Lead Alloys—Friction and Wear

Frictional and wear properties of copper-lead alloys are very important as the majority of these alloys are used in applications where it is essential that these properties be of a high order, e.g., bearings, slides, liners, etc. The presence of lead in the elemental state is all-important in these applications. Bowden and Tabor[6] have suggested that when copper-lead alloys form rubbing surfaces, in the absence of a lubricant, the lead tends to smear over the surface and form a thin film. This thin film of lead acts as an extreme pressure lubricant and lowers the friction between the contacting surfaces.

TABLE 3—TYPICAL MECHANICAL PROPERTIES OF SOME COPPER-LEAD ALLOYS

Alloy	Lead Distribution	Hardness, BHN	Ultimate Tensile Strength, ton/sq. in.
25 per cent lead, balance copper	Semi-continuous network	31	4.2
25 per cent lead, 1 per cent silver balance copper.	Semi-continuous network	31	4.3
25 per cent lead, 2 per cent tin, balance copper.	Globules	46	7.1

It has also been suggested that the good machining characteristics of leaded brasses and bronzes are due to the formation of this lead film on the surface during cutting. Observations of the machining of copper-lead alloys of high lead content indicate that this is indeed the case. Frequently, the chips produced are leaden gray in appearance, whereas the machined surface possesses the characteristic reddish appearance of copper.

That the gray color of the chips is due to a thin lead film formed as a result of high local temperatures can be shown by testing with a lead etchant, e.g., hydrogen peroxide-acetic acid mixture. The thin lead film is immediately dissolved and the chips assume a reddish appearance. The advantage of such a lead film in bearings is that it tends to minimize bearing seizures.

Table 4—Typical Specifications for Lead Bronzes

Alloy Specification	Composition, per cent					Applications
	Copper	Tin	Lead	Zinc	Others	
SAE 660	81–85	6.5–7.5	6–8	2–4	———	Bronze bearing castings
ASTM B144 (Alloy 3C)	83–86	4.5–6	8–10	0.5–2	Nickel 0.50	
ASTM B144	77–81	9–11	8–11	0.75 max.	Nickel 0.50	Sand castings
ASTM B30 (Alloy 3D)	76–79	6.5–7.5	14–16	0.75 max.	Antimony 0.75	Sand castings
ASTM B66 (Med. Bronze)	69–79	6–8	14–22	1.25 max.	0.75 max.	Locomotive wearing parts (sand or metal molds)
ASTM B66 (Soft Bronze)	64–70	6–8	23–27	0.75 max.	0.75 max.	Locomotive wearing parts (usually metal molds)
ASTM B144 (Alloy 3E)	67–71	4.25–5.5	23–27	0.50 max.	Nickel 1.0	Sand castings

Bowden and Tabor[6] have shown that the distribution of the lead plays an important role in the frictional behavior of copper-lead alloys. Those alloys possessing a more or less continuous lead network possess better frictional properties than the alloys in which the lead is globular in habit. In the former type, the channels of lead provide a continuous supply of lead to the rubbing surface, particularly if the bearing becomes very hot, whereas in the latter case only a limited supply of lead is available at the surface.

In silver-lead aircraft engine bearings a thin film (0.001 in.) of lead is electroplated on a silver backing which is very resistant to fatigue and possesses good thermal conductivity but lacks good frictional properties. The frictional properties of the surface are considerably enhanced by the presence of the thin, soft lead film.

Copper-Lead Alloy Applications

Copper-lead alloys of high lead content are used principally in applications where good anti-frictional properties are required, e.g., in bushings and bearings. The alloys are sand cast or chill cast, depending on the composition of the alloy and the actual application. For example, the alloys containing tin (leaded bronzes) are frequently sand cast. The globular habit of the lead in this type of alloy minimizes segregation, which occurs more readily in the alloys in which the lead is present as a semicontinuous network around the copper crystals. Typical compositions used for bearings and bushings are shown in Table 4.

The alloys used for heavy-duty bearings in car, diesel and airplane engines usually possess a high lead content (20-30 per cent) and only small quantities of other alloying elements. Typical compositions are shown in Table 5.

These alloys have excellent bearing properties, but as their mechanical properties are inadequate they usually are bonded to a steel shell. Some overseas methods for producing these bearings have been described.[7] During the war, methods were developed locally for the use of manufacturers.[8] The problem was to bond firmly to steel backing a thin layer of copper-lead bearing alloy with a fine structure completely free from defects such as lead segregation and shrinkage porosity.

Figure 6 *B* shows a typical cross section of an aircraft engine main bearing. The alloy is similar to No. 3 referred to in Table 5; the lead is visible as a gray network. Somewhat coarser structures are quite satisfactory for automobile and diesel engine bearings. Figure 6 *C* shows an example of bearing lead segregation which should be avoided in these bearings, as it frequently leads to a failure such as is shown in Fig 6*D*.

Table 5—Typical Copper-Lead Bearing Alloys Used in Aircraft and Diesel Engines

Alloy No.	Composition, per cent				
	Lead	Tin	Silver	Nickel	Copper
1	25–30	1	—	—	balance
2	25–30	—	0.75	—	balance
3	25–30	—	—	1	balance
4	15–20	8	—	—	balance

Overseas, the technique of handling such copper-lead alloys has reached a stage of refinement such that the alloy can be bonded to a continuous steel strip, either by casting or by sintering. The resultant structure is quite uniform and the bearings have been extensively used in cars and trucks throughout the war.

In conclusion, it must be emphasized that many of the difficulties encountered in the treatment of copper-lead alloys arise from a neglect of the principles outlined in the foregoing. If these are appreciated, and if such important matters as temperature control and deoxidation are not overlooked, most copper-lead alloys should prove quite amenable to treatment.

Acknowledgments

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ELECTROCHEMICAL CLEANING OF A LARGE STEEL CASTING AN EXPERIMENT

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An experiment was conducted to determine the possibilities of removing fused sand and iron oxides from the interior of a large cast steel turbine shell with the use of an electrolytic molten caustic bath. The major problems of handling the casting and auxiliary equipment were satisfactorily overcome. The portion of the casting immersed in the bath was successfully cleaned of fused sand and oxides. The process offers possibilities for development in step with the increasingly severe service requirements.

During the recent war a process was developed at one of the company's plants for electrolytic molten caustic cleaning of small parts. This process was successfully used over a period of several years for the cleaning of small castings and forgings. Sand, scale, grit, dirt, oils and greases were satisfactorily removed prior to tinning, plating and soldering operations. The results obtained by this method were far superior to any other method available, both from the standpoint of time required and effectiveness of results. This early work was the basis for the cleaning of a large casting as reported upon in this paper.

Experimental Installation

As shown in Fig. 1, the experimental installation consisted of a motor generator set rated at 5000 amperes at 6 volts, a fabricated steel tank with immersion type gas burners, and the necessary fixtures for handling the casting. The tank, which was 8x10x4 ft, was sunk below floor level in an abandoned molding pit.

Since it was planned to use this installation for only one cleaning cycle, it was necessary to provide means for disposing of the molten caustic upon completion of the experiment. The tank was provided with a drain near the bottom controlled by a gate valve. The valve was manually operated. The handle for operating this valve may be seen in Fig. 1. This drain discharged into another pit adjacent to the tank pit. A crane-suspended ladle was filled with molten caustic and the caustic poured into 55-gal steel drums. After solidification the caustic was diverted to other uses.

The complete lifting device and electrode holder is illustrated in Fig. 2. This apparatus was assembled to the casting prior to preheating of the casting and remained in place until completion of the cleaning cycle. The electrode supporting rod was constructed of 1½ in. diameter copper above the bath level and 2 in. diameter steel below the level of the bath, with four bus bars each ¼ x 4 in.

Approximately 19,000 lb of flake caustic soda was charged into the preheated tank. The remaining 11,000 lb was added in smaller batches at intervals during the first 24 hr of melting. A total time of 38 hr was required to completely melt the caustic. During the melting operation it was determined that the melting temperature was 300 C.

No particular difficulties were encountered in melting the caustic, aside from the time consumed. This time is not considered excessive in view of the large amount involved in the experiment. The temperature of the molten caustic was easily maintained between 400-450 C. The bath temperature after melting was quite uniform, with a maximum variation of approximately 10 C between different points in the bath at any time. All bath temperatures were taken with an immersion type recording pyrometer.

Preheating the Casting

The complete assembly of casting, lifting device, and electrode holder with electrodes in place, as shown in Fig. 2, was preheated in an electric car bottom furnace to 400 C. The casting temperature, as measured by a

Fig. 1—Developmental installation for experimental cleaning of steam chest portion of cast steel turbine shell by electrolytic molten caustic method.

Preprint No. 48-23. This paper will be presented at a Steel Session of the 52nd Annual Meeting, American Foundrymen's Association, in Philadelphia, May 3-7, 1948.

contact pyrometer during the transfer of the preheated casting from the furnace to the tank, was 300 to 325 C. These readings were taken approximately 5 min after the car bottom was pulled, and when the casting was resting on the foundry floor at some distance from the furnace. The purpose of preheating was to eliminate all moisture and prevent chilling the bath of molten caustic.

Introducing Casting Into Molten Caustic

An overhead travelling crane was used to slowly lower the casting into the caustic bath. Great care was exercised in this operation because it was realized that there was danger of air trapped in the cored openings expanding when heated, and ejecting molten caustic from the casting cavity. Although considerable agitation occurred within the casting, there was no splashing of caustic beyond the confines of the tank and no undue hazard to operators. The greatest amount of agitation seemed to come from gases generated by the reaction between the caustic and silica.

After the casting was in place on the supports provided, the crane was disconnected and electrical connections made. One side of the bus was connected to the electrode support bracket, and the other to the lifting device. The connection consisted of four 1/4 x 4 in. copper bars for each side of the circuit. It was necessary to clean the oxide from the copper bars before bolting up the connection. This required about 30 min, and it was necessary for the electricians to wear protective clothing and work behind asbestos shields because of the reflected heat.

Oxidizing Cycle

With the casting positive, power was applied for approximately 3 min at 2200 amperes. This resulted in an oxidizing condition which would have removed any organic material present, such as grease or oil. Actually, this cycle was unnecessary because of the preheating to 400 C.

The polarity was reversed and cleaning was continued at approximately 4000 amperes and 6 to 7 volts for approximately 2 hr. During this cycle, considerable agitation occurred in the interior bores of the casting, particularly around the electrode ends. There was some evolution of gas and caustic vapor from the tank. This vapor was objectionable only when operators placed their heads directly over the tank.

At the end of this 2-hr cleaning cycle, the power was shut off, the leads disconnected and the casting removed from the bath for inspection. It was observed that a considerable amount of cleaning had been accomplished. In some areas the cleaning was incomplete and, in the particular area where fused sand had been observed prior to cleaning, an appraisal of the results was impossible because of inability to observe this portion while the casting was suspended from the crane. Observation of the casting required approximately 30 min.

Further Cleaning

The casting was returned to the bath, electrical connections restored, and cleaning resumed. At the end of the 2 1/2-hr period of additional cleaning, the casting was removed and the caustic allowed to drain off. The temperature of the casting upon removal from the bath, as measured by contact pyrometer, was 360 C on

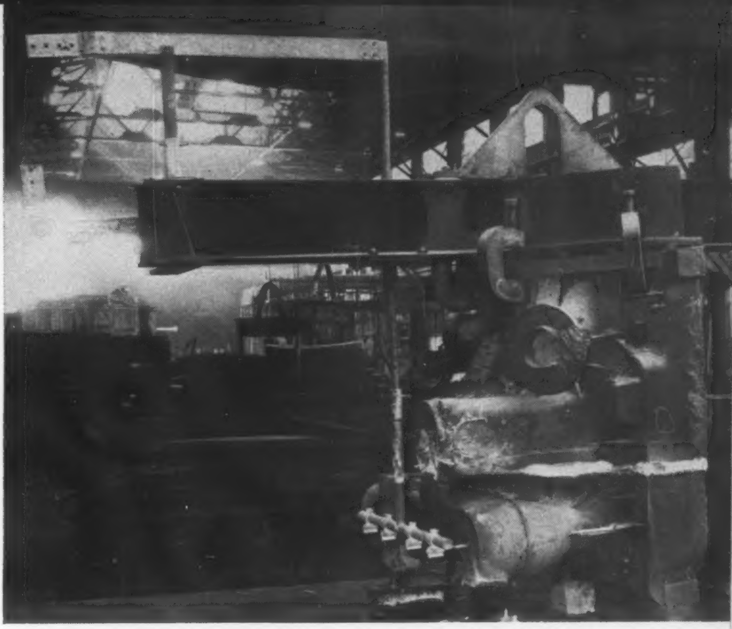


Fig. 2—Steam turbine shell casting with lifting device and electrodes in place, after steam chest portion of casting was experimentally cleaned by electrolytic molten caustic method. Note surface conditions above and below line marking immersion depth.

the cleaned surface and 260 C on the portion of the casting which had not been immersed in the caustic.

As may be seen in Fig. 2, only the steam chest portion of the casting was cleaned during the experiment. The reasons for confining the cleaning to this portion of the casting were threefold:

1. Most severe conditions of fusion and penetration are encountered in the steam chest portion of these castings. Any results accomplished on this portion of the casting would be easily duplicated on other parts.
2. The steam chest portion of the casting is the part which is subjected to the high pressures and temperatures in service, and it is therefore the most critical.
3. By confining the cleaning to the steam chest end of the casting, it was possible to keep the installation within practical size and cost limits.

Washing the Casting

After cooling to room temperature the casting was removed to an isolated yard area and washed with a fire

Fig. 3—Caustic being washed from cast steel turbine shell, steam chest portion of which was experimentally cleaned by electrolytic molten caustic method.

Fig. 4—Cast steel turbine shell, steam chest portion of which was cleaned by electrolytic molten caustic method. Close-up view showing typical fused sand conditions on exterior fillets not cleaned.

hose. It required approximately 6 hr for this operation (Fig. 3). Checks for remaining caustic were made by the use of litmus paper and phenolphthalein.

The casting used for this experiment is known as a "turbine shell lower," with an analysis of carbon, 0.20, manganese, 0.76, silicon, 0.37, and molybdenum, 1.10 per cent. Pouring weight was 43,300, and shipping weight 18,000 lb. This is a representative example of the larger, more complicated, and critical castings made in the Schenectady Works steel foundry of the company for steam turbine use.

Because of the intricate coring and a design involving extremely heavy sections, this type of casting is subject to the occurrence of considerable fused sand and metal penetration in the outside fillets and interior cored openings (Figs. 4 and 5). By close control of raw materials and foundry practices, these conditions have been minimized to the extent that they present less of a problem than was the case in the past. However, even under present improved conditions cleaning represents a major element of cost.

The particular casting chosen for this experiment contained an unusual amount of fused sand and penetrated metal. It was conservatively classified as "worse than average" before caustic cleaning.

Penetration and Fusion

Mechanism of metal penetration into sand has been the subject of considerable investigation and theorizing. Its removal from steel castings has always been a major cleaning problem, particularly in foundries producing heavy-section castings. As normally encountered it consists of a network of metal particles of minute cross section mixed with fused sand (Fig. 4). In the removal of this material, shotblast is quite ineffective and chisels are readily dulled. If conditions permit, a chisel can sometimes be inserted between the casting and this conglomerate, and pieces can be removed by prying. Sometimes it can be pulverized by

Fig. 5—Steel turbine shell, steam chest portion of which was cleaned by electrochemical process. Compare cleaned and uncleaned portions of casting. Steam chest only was cleaned. Note condition of fillets and absence of burning slag on horizontal joint at cleaned end.

lengthy pounding with a pneumatic hammer and chisel. In inaccessible cored openings this is quite time consuming.

In the case of the subject casting the electrolytic molten caustic cleaning process completely removed all traces of silica particles except in the two center pockets of the port chamber. In this area fully 80 per cent of the fused sand was removed, and it is certain that a brief extension of the cleaning cycle would have completed the removal. The small amount of fused sand remaining, due to too short a cleaning cycle, was quite fragile, and the author was able to pulverize it with a cold chisel and machinist's hammer (Fig. 6).

Several samples of penetrated metal, after removal of sand in the caustic bath, were combined and analyzed for composition. These results are compared with casting composition as follows:

Component	Casting	Penetrated Metal
Carbon, per cent	0.20	not analyzed
Manganese, per cent	0.76	not analyzed
Silicon, per cent	0.37	0.22
Molybdenum, per cent	1.10	1.38

These results prove conclusively that the penetrated metal is not ferrous silicate nor iron oxide, as has been claimed by other investigators. The material is definitely the same as the casting. Still unexplained is the mechanism which will permit steel tapped at 2850 F and poured from a 20-ton bottom pour ladle to "run needles."

Following molten caustic cleaning the casting was heat treated at 1050 C. After heat treatment the metal penetration was found to be quite fragile so that almost all of it could be rubbed off with the finger tips. Apparently, it had become completely oxidized (Fig. 7).

Figure 8 illustrates the progressive removal of fused sand from this casting. In the case of (*A*) the material is shown as normally encountered; (*B*) some removal of fused sand has taken place; (*C*) illustrates complete removal of fused sand with the penetrated material remaining. Laboratory indications confirm these observations as follows:

	A	B	C
SiO_2, per cent	43	46	Trace
Metallic Iron (Fe), per cent .	56	31	97
Iron Oxide, per cent	Small Amount	21*	Small Amount

* Probably due to anneal.

Fig. 7—Cast steel turbine shell, steam chest portion of which was cleaned by electrochemical process. Close-up view shows easily removed searched or penetrated metal remaining in exterior fillets after heat treatment at 1050 C and after removal of fused sand.

The casting which was the subject of this experiment had not been annealed or heat treated. As a result no evaluation of the efficiency of this process in removing annealing scale is possible in connection with this particular experiment. However, in the previous work done with small parts in another plant of the company, it was conclusively demonstrated that this process readily removed annealing scale.

Also, in the case of the present experiment, oxide resulting from prior flame cutting operations was readily removed. This is evident in Fig. 5, where the portion of the heavy flange which was immersed in the caustic is entirely clean of flame-cutting oxide and the remainder of the flange has a heavy coating. If this process were applied to production operations it would be desirable to perform the cleaning after annealing and heat treating operations. This procedure was impossible in the case of the subject experiment because of production requirements.

Experimental Installation

Cost of the experimental installation for conducting this cleaning process was considerable when related to its value in the cleaning of one casting. However, analyses of this installation cost and the operating cost for the experiment indicate that they are not so high as to preclude the possibility that a production installation could be economically justified.

Analyses of foundry cleaning costs on the subject casting indicates that, as a result of the electrolytic cleaning process, cleaning direct labor costs were reduced by one third. These costs would have been further reduced if the casting had been previously heat treated so that the electrolytic caustic cleaning method would have reduced or eliminated a shotblast operation.

From an engineering standpoint, there seems to be considerable merit in the further investigation of this

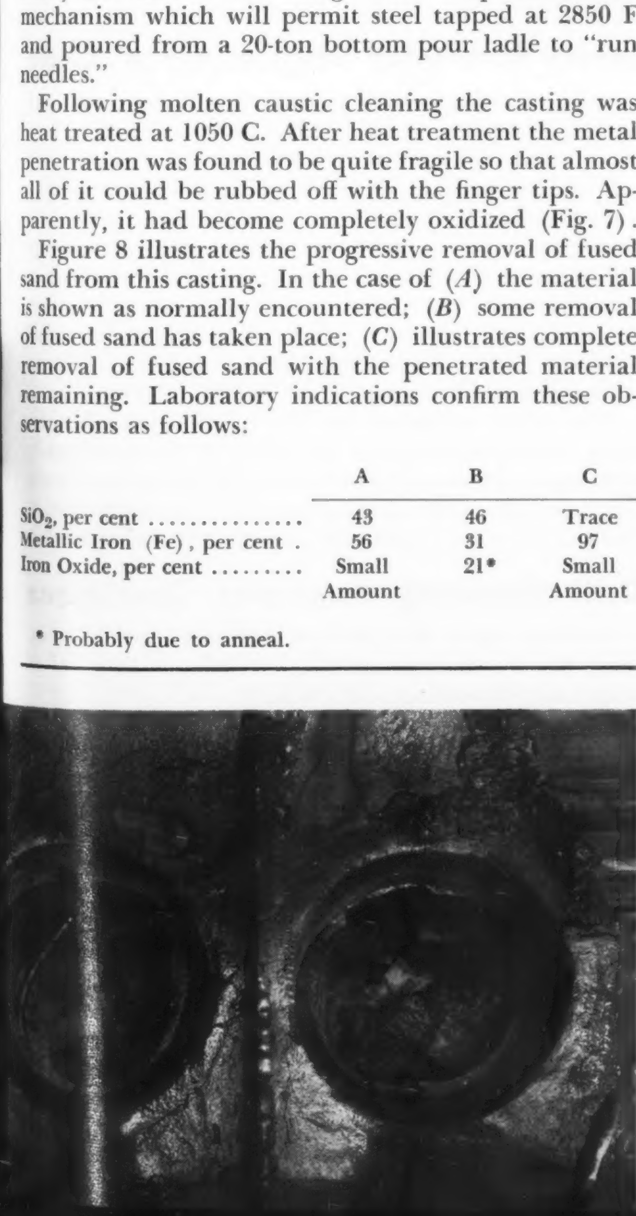


Fig. 6—Steam turbine shell casting. Steam chest portion was cleaned by electrolytic molten caustic method. Close-up view shows condition of cored openings in port chamber after cleaning. Some fused sand, which is quite fragile, remains after too short cleaning cycle.

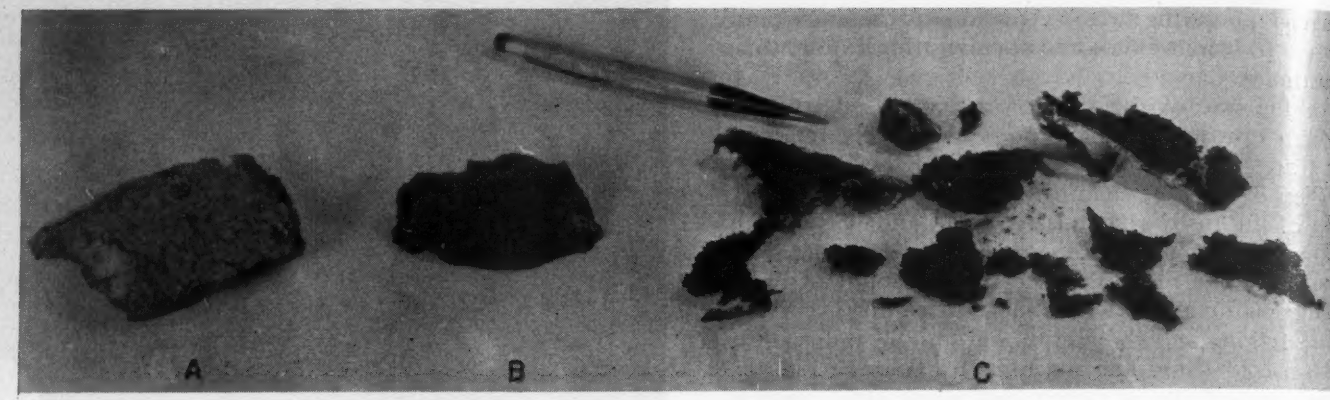


Fig. 8—Fused sand from steam chest portion of cast steel turbine shell cleaned by electrolytic molten caustic cleaning method. A—Piece of fused sand and metal penetration removed from portion of casting not cleaned by this method. B—Piece of fused sand and metal penetration removed from one of center pockets of port chamber. Note change in color. See report for chemical analysis. C—Pieces of metal penetration after complete removal of fused sand in molten caustic bath.

process since the requirements for steam turbine castings are becoming more severe. Operating temperatures and pressures are steadily increasing. The production of better castings to meet these increasingly more rigid requirements must involve the development of better foundry methods and controls.

Conventional hand methods for the removal of fused sand from cored passages in complicated steam turbine castings are slow and in some cases uncertain. Despite close supervision, qualified operators, and the best of equipment, it is conceivable that 100 per cent removal of sand particles from steam passages may not always result. Chemical dissolution of sand deposits is a certain method of assuring absolute freedom from embedded and fused sand.

Hand methods of removing sand from castings are not subject to good control. Controversy sometimes results from the effort to equitably compensate operators for this type of work. A chemical method of performing this operation would seem to lend itself to better control and elimination of controversial factors.

Safety Problems

Conduction of this experiment involved protection against a number of hazards. Operators were protected by asbestos clothing and rubber clothing as required. Respirators and splash-proof goggles were provided. Guard rails were installed and provision was made to operate heating burners from outside the tank.

Every possible precaution was observed in the handling of the flake caustic and molten caustic to prevent the possibility of this material coming in contact with the operator's skin. All operators were carefully instructed regarding the hazards of handling the caustic. As a result of the precautions taken no accidents were encountered in connection with this experiment. Upon completion of the experiment, it was generally agreed by all concerned that molten caustic in a large quantity, such as was involved, could be successfully and safely handled without encountering any undue hazard.

Experience gained from this experiment indicates that foundries producing complicated steel castings for high temperature and high pressure service might profitably investigate the possibilities of utilizing electrochemical methods for cleaning certain types of castings. Indications are that demands for higher quality steel castings may involve the development of methods which will insure the production of castings entirely free from embedded fused sand. This method offers possibilities from the standpoint of obtaining better control of labor input for cleaning operations.

Editor's Note: A possible explanation of metal penetration is offered in the article, *"Does Metal Vapor Cause Sand Penetration?"*, on page 139.

Safety Reminder Utilizes A.F.A. Code

SOME FOUNDRY FOREMEN SAY they "just don't get around to reading any kind of book or pamphlet" and have expressed need for refreshers on safety practices.

With this need in mind, the Orcutt Industrial Engineering Co., Milwaukee, an organization engaged in setting up and administering a safety program in several Wisconsin foundries, is printing and distributing a pocket-size "Supervisor's Safety Reminder," featuring excerpts from one of the six A.F.A. Safety and Hygiene Codes, RECOMMENDED GOOD SAFETY PRACTICES FOR THE PROTECTION OF FOUNDRY WORKERS.

The safety reminders will be reissued periodically, using other excerpts from the A.F.A. codes, as a handy running review of safety practices, officials of the Orcutt Co. have announced. The program encourages continual review of Association health and safety codes.

Drill Grinding Improves Specimens

WHEN A PIECE OF STEEL OR OTHER METAL is to be analyzed, the chemist sometimes receives a handful of long, curly unmanageable chips.

These chips are difficult to work with and take more of the chemist's time than an analysis should require.

There are many laboratory workers who are not aware that fine, short chips can be easily obtained by grinding the tip of an ordinary drill nearly flat, according to C. O. Lundberg, Norton Company Research Laboratories, in a recent article in *Grits & Grinds*.

For example, a standard drill with 118° included angle results in long, curly chips, while a drill whose tip has been ground to an included angle of 160° gives the desired fine chips. The exact angle is not important.

Increasing the drill speed and using a light pressure will produce even finer chips.

GRINDING STANDARDS HELP ELIMINATE CLEANING ROOM BOTTLENECKS

Dean Van Order
Industrial Engineer
Burnside Steel Foundry Co.
Chicago

An even flow of castings through the cleaning room has long been recognized by foundrymen as an important factor in establishing sound and economical casting costs. During the war, when many plants were being pushed beyond capacity, the bottleneck tendencies of the cleaning room were more than ever apparent. Not only did the cleaning room have to correct errors of the foundry, but also had to devise new ways of handling this increased production at a minimum cost. Foundries which previously had no incentive plans in the cleaning room found it necessary to install them; foundries with established plans had to bring them up to date if they intended to handle this increased burden.

Progressive foundries desiring to meet present-day competition soon realized that they had to maintain a better control on cleaning room costs. Grinding, being one of the larger operations in the cleaning cycle and also one of the easier cleaning tasks on which to establish piece rates, was quickly selected by time and methods engineers for standardization and methods improvement. The value of a good incentive plan on stationary or swing grinding can be readily recognized by cost-minded supervision. The plan presented in the paper is in operation at the present time; it is one that is simple to maintain and readily adapts itself to any method changes.

Management and Supervision Must Cooperate

Too often, time study engineers make the mistake of not laying the groundwork for installing an incentive plan before they actually take studies. Management and supervision must be thoroughly sold on any plan; they must be presented with at least a rough estimate of the cost of installation and the benefis and savings to be derived. Management and supervision must be completely in accord with the plan.

It is definitely the problem of the time study engineer to sell his ideas to management and supervision. The time study department should be the source of all costs and, therefore, an essential part of the business organization. A department as important as this cannot be turned over to just any individual. Almost any man with an average education and common sense will produce accurate time studies, but an ability of far greater magnitude is needed to sell and keep sold the mechanics of time study and methods work. The human problems encountered by the time study man must be worked out with the help of management and supervision.

The time study department is strictly a service to supervision. Foremen must feel free to ask the time study man to assist them in their production problems. Quite often supervision is kept in the dark as to time study and methods procedures, resulting in poor cooperation. It is the job of the time study engineer to convince the foreman that it is to his advantage to report all delay time, method changes, and any irregularities in the production schedule of his department.

Since the cleaning room contains the most varied operations in the modern foundry, it is essential that the time study engineer have the complete confidence of its foreman. In return he must recognize all the problems encountered in the cleaning room, realizing that they will not be corrected overnight.

Improve Methods

Before any new incentive plan may be installed, or the old one revised, present methods should be thoroughly scrutinized. What can be done to improve present grinding operations? The following factors should be investigated:

1. Sequence in which castings flow through the cleaning room, with particular attention to backtracking.
2. Possibility of improving the pattern match between cope and drag in order that the parting line or amount of fin to be ground may be decreased or even eliminated.
3. Improvement of core boxes and core prints to eliminate some of the potential core fin.
4. Excessive use of nails and vents. These are costly items in snag grinding, the ratio of grinding wheel cost to the amount of metal removed being quite high. On heavy work, removal of nails and vents by chipping may reduce costs.
5. Use of flogging or necked down cores to reduce the contact and grinding area.
6. Changing the location of heads or gates to make them more accessible to the large grinding wheels. Metal can be removed at much lower cost on a wheel of large surface area than on a wheel of smaller area.

Preprint No. 48-28. This paper will be presented at a Job Evaluation and Time Study Session, 52nd Annual Meeting, American Foundrymen's Association, in Philadelphia, May 3-7, 1948.

7. Use of the proper grade of wheel for the average type of castings ground. The grit size, hardness, and bond of the grinding wheel have a direct bearing upon the speed with which the metal can be removed and the life of the wheel itself.

8. Pressure bars may be used to advantage on stationary grinding.

9. Methods of holding castings rigid for swing grinding may be improved. Vibration will tend to break down grain structure in the grinding wheel and also retard its cutting action.

10. Castings should be properly burned with only a minimum of metal left for grinding.

11. Grinding operators should be properly instructed in the best grinding techniques.

No doubt, alert foremen and time study engineers will be able to add other method improvements to this check list. Methods which are improved before studies are taken will reduce the future work of the time study men. Method changes made after standards have been set necessitate a change in standard tables, standard data and a selling job done on the employee; however, any method changes that have to be made after standards have been established should be corrected immediately. If neglected, they will result in either poor employee relations or loose standards.

Adequate Time Studies

Various sizes, shapes and weights of castings produced in a miscellaneous jobbing foundry necessitate that a sufficient number of studies be taken on grinding operations. In the opinion of the author, the number of time studies taken should vary somewhere between 50 and 100 on each type of grinding (swing or stationary), depending on the variation of work.

The time study engineer must use his own judgment on the type of castings to study; however, he should try to cover: 1. A variation in weight; 2. numerous head and gate sizes; 3. various locations of heads and gates; 4. amount and location of fin; 5. number and location of nails and vents.

Since most present-day foundries have had to produce numerous types of metal to meet competition, another problem confronts the time study man. Allowances must be made over and above the regular types of steel produced to take care of the additional grinding time needed on certain high-alloy and high-carbon metals. The time study engineer must collect sufficient studies on this type of work to enable him to determine these additional allowances. If the standard table is based on studies made on the simpler and more common types of metal, then one or two additional percentage allowances probably will take care of the remaining types of metal.

The time study man must know something about grinding operations before he can take any studies; he must be familiar with the types of metal, and the inspection requirement on each. Grinding is one operation where the engineer may be misled on pace rating. In determining whether the operator is using effort to remove metal, he must watch the amount and color of the sparks. An ammeter can be installed on each grinding wheel to help determine how much pressure is being exerted by the operator.

An analysis of the elements in the grinding operations should be made before taking studies. If the variable and constant elements and their unit of measure are recognized beforehand, the time study observer will be able to do a much better job of breaking up the elements on the time study sheet. The selection of the proper unit of measure for each element is the secret of establishing a good standard table. The time for grinding heads will vary with the size or area of the head, not the weight of the casting; likewise, handling the casting will vary with the size or weight of the casting and not the area of the heads.

At the present time, three swing frame grinders located side by side are in use in this plant. All machines are equipped with a fully enclosed 15 hp motor. The belt is a double "V" of sufficient length to reach from wheel pulley to motor pulley. The stands on which work is placed are built up of welded sections of flask filled with molding sand. This type of bench is ideal for swing grinding as it absorbs any vibration built up by the action of the wheel on the casting.

Six stand grinders are used for grinding smaller castings. All machines are 15-hp single motor with double grinding wheels; belt drive is used with four "V" belts on each wheel.

Extensive tests were made on grinding wheels to determine the best grade of wheel for the average type of castings ground. The wheel selected was the one giving the best life with the greatest amount of metal removed in the shortest time. Wheel dimensions were 24-in. outside diameter and 3-in. thickness. Tests were conducted on grinding wheels by weighing both the wheels and the casting to be ground before and after grinding to determine the amount of metal removed for each pound of wheel loss. Ammeters were installed on each grinding machine that was used for the test to determine if the operators were applying a uniform amount of pressure.

Since the wheels selected were high speed and used both on the stationary and swing grinders, a surface speed of approximately 9,250 fpm was recommended on all grinding machines. New wheels are placed on the swing grinder and used down to 18 in., from whence they go to certain stand grinding machines where they can be used down to the safety rim. By changing the wheels from machine to machine as they are reduced in diameter, it is possible to maintain approximately the same surface speed at all times by increasing the spindle speeds on the various grinding machines.

Establish Standard Data

All studies were taken by the snap-back method, two time study watches being used; one watch clocked the time for each element, and the other clocked the overall time for the entire cycle. The snap-back method was used because of the smaller amount of clerical work entailed in figuring studies, and the ease with which the time study man could follow the operator if he changed the sequence of the elements during the study, as will occasionally happen when timing miscellaneous operations.

Complaints arising from the loss of a certain amount of time or leaving out elements or delays when using the snap-back method was eliminated by the use of the second watch to check the sum of the readings for each element in every complete cycle. The overall time for each cycle must agree within a few one-hundredths of a minute with the sum of the readings for all the ele-

—TIME STUDY SHEET—

Customer— *John Doe*

Study No. *# 6*

Operation No. *Stand Grinding*

Pattern No. *Y - 567*

Dept.	Floor	Clock No.	Machine No.	Type Mch.	Fixture No.	Material
G		*#20*	*# 2*	*Stand 3" Wheel*		*#1 Steel 135-160 Br.*

Part No.

Part Name *Front Wheel*

Dwg. No. *Support Adapter*

Observer *W. L.* Date *6-5-40* Elapsed Time *10:01* To *10:15* Speed and Feed O.K.—

Description of Operation — *Grind all fin and all heads & gates except one, on 3" wheel - Stationary grinder*

STANDARD *1.91 Minutes*

Elements of Operation	1	2	3	4	5	6	7	8	9	10	Total	Actual	Code Relax.	Stand.
1 - Complete	1.22	1.35	1.50	1.56	1.69	1.15	1.44	1.40	1.63	1.64				
Pickup & position 23.5# wt	.12	.08	.11	.08	.12	.11	.09	.10	.09	.11	1.01	.101	65 / 120	.13
*Grind Fin * total of 41"*	.10	.11	.12	.16	.11	.09	.12	.11	.17	.10	1.19	.119	70 / 1.25	.17
Grind Gate 2 x ½ regular	.20	.17	.23	.18	.32	.19	.18	.22	.19	.31	2.19	.219	50 / 1.25	.23
*Grind Fin *See note above*	.09	.11	.11	.16	.11	.08	.12	.10	.17	.10	1.15	.115	70 / 1.25	.17
Grind Gate 1¾ x ½ regular	.13	.11	.17	.12	.16	.12	.12	.16	.13	.15	1.37	.137	75 / 1.25	.21
Grind Head 2 x 1¾ - (½ irregular)	.51	.71	.68	.81	.82	.50	.72	.67	.82	.81	7.05	.705	65 / 1.25	.96
Casting aside 23.5# Wt	.03	.03	.03	.02	.03	.02	.04	.02	.03	.02	.27	.027	75 / 1.20	.04
	1.18	1.32	1.45	1.53	1.67	1.11	1.39	1.38	1.60	1.60	14.23	1.423		1.91

Notice - Fin condition very good. 2 x 1¾ head must be ground to the contour of the casting.

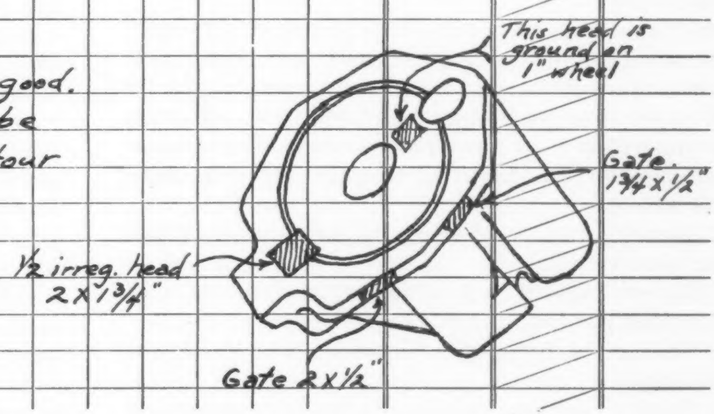


Fig. 1—Time study sheet for stand grinding on 3-in. wheel.

ments in that cycle (Fig. 1). If they do not agree, the time study man knows he has left an element out or missed some delay time.

The studies are broken down into elements, and each element is pace rated and quoted for fatigue independently. By pace rating each element, the time study man will derive a much more uniform curve when he plots the elements upon graph paper. Pace rating is expressed in terms of 60 units per hour being normal; this would correspond to 100 per cent as normal under a percentage system of rating.

Fatigue or rest allowances vary from 15 per cent for light castings handled on the stand grinder, to 40 per cent for heavy castings handled on the swing grinder. All castings which had to be handled by hoist were given a flat 20 per cent fatigue allowance for handling.

Study number	#1	#2	#3	#4	#5	#6
Patt. number	M 2617	28672	16384	N-1	386	Y-567
Customer						John Doe
Operator No.	#20	#16	#15	#16	#20	#20
Date taken	4-10-40	4-12-40	5-18-40	5-25-40	5-26-40	6-5-40
Casting Weight	6.5	22.	9.	3.1	16.	23.5
Grind Hds or Gate - Size	3X1 - .97	4X1 - .72	3X2 - 1.33	1X1 - .23	3X1 3/4 - 1.24	2X1/2 - .23
" " " " "	2X3/4 - .43	5X3 - 2.29	2X1 3/4 - .45		2X1/2 - .21	1 3/4X1/2 - .21
" " " " "			1"D - .30			2X1 3/4 - .96
" " " " "						1/2 irregular
Grind Fin - Regular - Lgth.	40" - .31	62" - .51	17" - .14	12" - .22	27" .22	41" - .34
" " " "						
Grind Fin - Irregular - Lgth.			14" - .23			
" " " "						
Grind Vents - Size - No.	3/8"D-4-.31			7/8X1/8-1-08		
" " " "						
Grind Nails - Size - No.		3/8"D-4-.40			3/8"D-2-.15	
" " " "						
Handle - (Pick up & away)	.12	.16	.13	.07	.12	17
Total	2.14	4.06	2.58	.60	1.94	1.91

Fig. 2—Comparison sheet for stand grinding on 3-in. wheel, showing levelled times for each element.

Actual grinding was allowed 25 per cent fatigue on both stand and swing grinding. All pace rating and fatigue allowances are in increments of 5 per cent; that is, 15, 20, 25, 30, 35 per cent, etc. An attempt by a time study engineer to break down allowances any finer than this is purely a guess and will entail more clerical work.

The time study sheet must be a record of all conditions prevailing at the time the study was taken. This is very important, as the time study man must refer back to the time study sheet when recording all of his accumulated data on a comparison sheet. The important items that must be listed (Fig. 1) can be summed up as follows:

1. Date the study was taken with the name or initials of the observer.
2. Pattern number and customer for whom the casting studied is being made.
3. Number of the operator studied and overall time of the study.
4. Type of machine and size of grinding wheel upon which the casting was ground.
5. Type of metal and Brinell hardness at the time the casting was ground.
6. Brief description of the operation.
7. Part number or part name if one is supplied by the customer.
8. Brief description of each element breakdown with area of head or gate ground, length of fin, number and size of nail buttons and weight of casting.
9. Any unusual condition about the casting that might affect the time for grinding should be recorded; such as heavy fins, heads burned too high or too low, and the irregular location of head or gate which might require excessive grinding operations for removal.
10. A rough sketch of the casting with the location of the heads and gates is helpful to the time study man when he has to refer back to the study. The making of a sketch may depend, however, upon the time and ability that the time study engineer has at his disposal.

After a sufficient number of studies have been taken and computed for pace rating and fatigue, the levelled standard for each element is recorded on a comparison sheet. A comparison sheet is nothing more than a large sheet or sheets upon which all the levelled times for every element in each study are recorded side by side so that they can be compared (Fig. 2).

Each element is listed against the unit of measure selected for it; the standard for removing the heads or gates is listed against the area of the head or gate, the standard for removing fin against the length of fin, the standard for removing nails or vents against the number and size of nails or vents, and the standard for handling the casting against the weight of the casting.

After all elements have been recorded on the comparison sheet, the constant elements (those which do not vary with any unit of measure) can be totalled across the sheet and the average used as standard. The variable elements such as, grinding heads or gates on stand grinding (Fig. 3), are plotted on a graph and a curve drawn through the average of the points. The points on this curve make up the standard table for this particular element.

It is a good practice for the time study man after he has taken 15 or 20 studies to record them on the comparison sheet and plot the variable elements on a graph. By doing this, before too many studies have been taken, he can see certain elements or the range within elements where more studies should be taken, and avoid the waste of collecting unnecessary studies.

As previously mentioned, stand and swing grinding are among the simpler operations in the cleaning room upon which to establish standards. In both stand grinding and swing grinding, the area of the head or gate in square inches determines the standard for grinding. The time for removing metal on the swing grinder will be greater than that on the stand grinder as the heads generally are larger and the wheel must be moved to the work, which takes longer than moving the work to the grinding wheel. The standard for handling castings varies directly with the weight on both stand and swing grinding.

Castings ground on the swing grinder are paid an additional value, called resetting, for handling (Fig. 4).

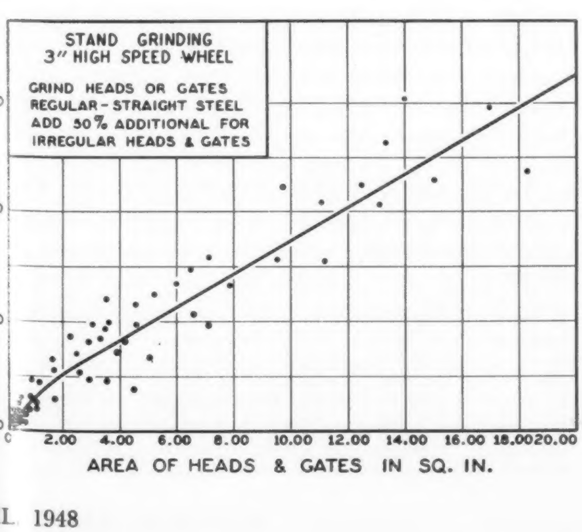
This value is paid each time the swing grinder must set his machine aside and move the casting in order to reach other grinding areas with his wheel. Resetting time is based on the weight of the casting, but does not take as long as handling which covers picking up the casting, placing on the grinding block, and finally setting the casting aside. Nails, vents and fins are not ground with the swing grinder as they can be removed by the chippers at lower cost.

After the curves have been drawn for each variable element, the time for that element may be expressed by the formula for the curve or recorded in tabular form. The use of a table to set standards is preferred as it is quicker and more accurate than applying a formula, in the opinion of the author. When deriving the tables from the curves, thought should be given to keeping them as simple as possible.

Elements which are classed by identical units of measure can be combined in the same table. Every effort should be made to eliminate any necessity on the part of the rate setter to interpolate values. Since standards are only average values, the bracketing of standards over a certain range will not change this average; for example, the removal of any amount of fin between 60 and 70 in. would carry the value for 65 in. of fin.

All information necessary to determine stand or swing grinding standards is recorded on a job specification sheet (Fig. 4). This information is recorded right from the pattern so that the piece rate can be figured before the casting is ground. The determina-

Fig. 3—Standard curve for grinding heads or gates on 3-in. width wheel on high speed stand grinder.



SWING GRINDING

Size of Cuts		No.	Std.
5 x 5	Reg. — ~~Irreg.~~	4	15.48
5¾ x 1⅜	Reg. — ~~Irreg.~~	2	3.16
	Reg. — Irreg.		
	Reg. — Irreg.		
	Reg. — Irreg.		
	Reg. — Irreg.		
	Reg. — Irreg.		
	Reg. — Irreg.		
	Reg. — Irreg.		
	Reg. — Irreg.		
	Reg. — Irreg.		
	Reg. — Irreg.		
Reset		4	7.96
Handling Wt 414 #			1.99
Gauge			
Surface			
	Total		28.59

STAND GRINDING

Size of Head or Gate	No.	Std.
4 x 2¾	1	2.03
1¾ x ⅝	2	.82
2 x 2 (irregular)	1	1.25
Size — Vents	No.	
¾ x ⅛	1	.09
Parting Reg.	Length 44	.31
Irreg.		
Nails — No. (touch up) ⅜" - 3		.24
Miscellaneous		
Wt. 12.5 #		
Handle		.14
Total		4.88

Fig. 4—Work sheets listing all items ground by stand or swing grinders.

tion of irregular heads, gates or fin is left to the judgment of the time study man or rate setter. Standards for items not covered by the table, such as gauging or grinding special surface areas, are determined by check studies unless there is sufficient quantity upon which to build a table. The specification sheet should be kept as simple and neat as possible.

Good Checking Control

After the standard table has been compiled, a precheck period of at least 2 weeks should be taken with the new standards. During this period, the time study man can check the table against actual performance to determine if any corrections are to be made before the standards go into effect. Also, while this precheck period is in effect, the time study man can instruct his checkers, or whoever will be responsible for keeping track of the operator's performance, on proper checking methods.

Checking may sound like a simple duty, and too often will be passed over lightly as far as instruction is concerned. Many time study engineers have had a good standard table appear tight or loose due to incompetent checking. Standards are only as accurate as their checking and maintenance of methods improvement. The employee selected to do the checking must be intelligent and honest; he must count accurately and report method changes to the standards department.

A savings in maintaining the piecework system can be made by combining the checking for piecework and inspection under one person. The employee doing the checking should have the authority to reject castings if the operator has not satisfactorily completed all of the elements included in his standard. The operator would not receive credit on his work sheet for castings ground until they met inspection requirements. Occasionally, certain irregularities will arise that are not covered by the standard table. The checker must record accurately the time and number of pieces ground under these conditions in order that the operator may be properly compensated.

In the opinion of the author, any foundry with a sound, intelligent organization can establish its own standards department and install accurate standards in the cleaning department, as well as in all other departments of the plant.

ALLOYING ELEMENTS EFFECT ON TENSILE PROPERTIES OF MALLEABLE IRON

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The effect of alloying elements on the tensile properties of malleable iron is so much obscured by other operating variables that any deductions from routine tests and analyses are open to suspicion. Direct experimental exploration indicates that, as expected, any alloy dissolving in ferrite strengthens it. The effects of successive increments in the concentration of a given element or of the presence of several elements are not directly additive but decrease as the total alloy increases. The effects of several alloys can, however, probably be approximated by converting all into equivalent amounts of a single alloy. Silicon seems to exert an effect on graphite form which may obscure its effect in the matrix.

It is well established that the tensile properties of completely graphitized malleable iron depend on the properties of the metallic matrix, and the amount and form of the included graphite. The effect of a unit of weight of graphite has been found in various studies to vary greatly, and it probably is a fair first assumption that this is due to variations in the size and sprawliness of the nodules.

In the present discussion it is proposed to exclude the effect of graphite by suitable selection of experimental conditions, and to consider only the effects of the ever-present elements—silicon, manganese, sulphur, phosphorus and chromium.

One approach to the question of the quantitative effect of chemical composition on tensile properties of any alloy is the deductive one of computing, statistically, the partial correlation coefficient of each element's concentration and the properties in question (if all other variables correlated with each concentration be kept constant). For example, additions of ferrosilicon probably affect the mechanical properties in two ways; by affecting silicon content, and perhaps by deoxidation. We must, therefore, concern ourselves with the partial correlation of silicon and strength (or elongation), ferrosilicon additions being assumed constant.

Similarly we must consider the effects of sulphur and manganese, ferromanganese and other elements of this pair being kept constant. While a correlation can be demonstrated between sulphur and sprue content in the mix, the effect of sprue in itself on physical properties is negligible and that variable may be disregarded in this instance.

If, by the accepted methods of statistics, a partial correlation coefficient of a given element's concentration and a given property can be calculated, it is a simple matter to compute the corresponding regression coefficient which states how much the given property is caused to vary by unit change (one per cent) in the given concentration. It will presently be seen that there is, in fact, little or no consistency to the regression coefficients computed from different populations necessitating detailed study of the standard errors of these coefficients, as computed by well established means.

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Since the mathematics is complex, no attempt is made in this paper to illustrate the calculations or demonstrate their reliability. The reader is asked to accept the procedure and calculation as authentic. The data represent four groups, each of constant carbon. They represent the daily average values of the relevant variables. Three plants are represented.

Table 1 gives the several regression coefficients of tensile strength of each of the four populations and the average regression coefficient weighting each plant equally.

Not only are large differences in magnitude shown, but even occasional differences in sign. Are these to be considered as real or as the result of chance? One may judge from the standard error of Table 2. The significance of the symbol ° in Table 1 is described in the discussion following Table 2.

Only the values marked ° in Table 1 are two or more times the corresponding ones in Table 2, and

Table 1—Regression Coefficients of Tensile Strength on Concentration (psi/1 per cent)

Group	A	B	C	D	Avg.
C, per cent	2.50–2.52	2.53–2.55	2.56–2.58	2.49–2.51	
Days, no..	52	71	84	59	
Si........	−2470	+4420	−6400	−17150	−7250
Mn.......	+15800°	+4020	+.81	+157	+3383
P........	+4930	+44500°	+27500°	−19500	+24220°
S........	+23400	+31800	+46000°	−5235	+22788
Cr.......	+34150	+17900	+15450	+24700	+17187

therefore have a reasonable certainty of being real and in the observed direction (2.5 per cent chance of accident).

These very large standard errors have the effect of making necessary very large differences in Table 1 between the regression coefficients in different populations before these differences are certainly real. Of all these differences only that between the regression coefficients of tensile strength on phosphorus for *B* and *D* can be taken as certainly real. The general significance is that the scatter of values due to any particular element is so small compared to the total scatter that we are unable to get any data from any of our single populations sufficiently accurate to warrant carrying over into another.

In such cases one hopes for better precision from average values. Comparing the averages of Table 1 with their standard error in Table 2, it is seen that the chance that the regression coefficient on silicon is positive instead of negative, i.e., that silicon actually does not weaken the iron, as it seems to do, is (from the appropriate probability tables) about 0.062, or 62 in 1000. Similarly, the chances that the other elements do not strengthen the iron are: manganese, 0.195; phosphorus, 0.0005; sulphur, 0.015, and chromium, 0.145. The chances are, therefore, reasonably good, but convincing only in the case of phosphorus, that silicon decreases tensile strength and all the other elements increase it. The average values of Table 1 are the best quantitative estimates of their effects, but except for phosphorus and sulphur precision is low.

Tables 3 and 4 have the same relation to elongation as do Tables 1 and 2 to tensile strength. The meaning of the symbols * is as previously described.

It is at once evident that none of the values in Table 3 is numerically as great as the corresponding numbers in Table 4, and hence it cannot, by that test, be stated with certainty that composition affects elongation. Even the standard errors of the averages are large. The probabilities that silicon and chromium do not decrease elongation are 0.295 and 0.450, respectively, and that the other elements do not increase it are 0.255, 0.315 and 0.160 for manganese, phosphorus, and sulphur, respectively.

The conclusions, such as they are, are valid only within the range of composition for which the data were gathered. This represents a region of the composition shown in Table 5. The reason for this restriction will be further evident later in the paper.

The great uncertainties in the conclusions of this bulletin arise out of the impossibility of excluding in any commercial process all the variables except a very few. They could presumably not be eliminated by any method which did not secure greater constancy with regard to even the unknown factors. It is scarcely feasible to operate for an extended period at, say, a low level of phosphorus, and for another at a high level, and still less so for elements like silicon whose usable range is limited. Operating with furnace, or ladle, additions to part of each day's run introduces a new and unknown variable; thus it would seem that the possibilities of improving the data on which such studies might be based are exhausted.

An inductive approach based on direct experiment may also be attempted by measuring the effects of the

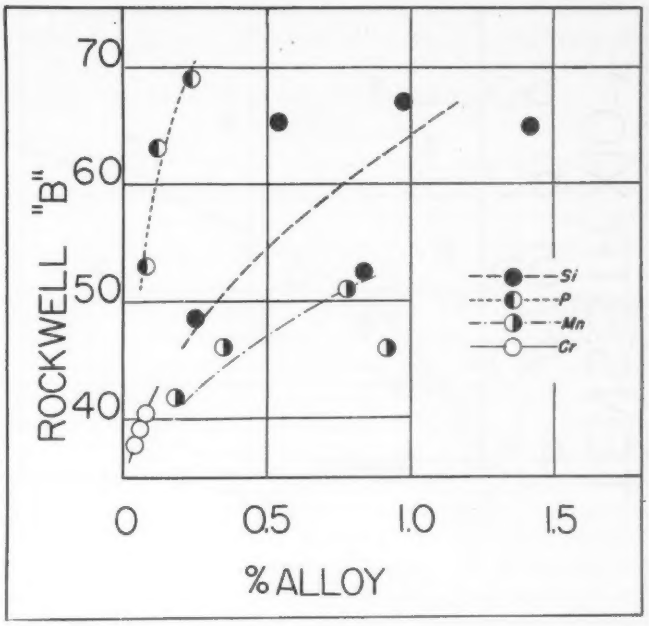

Fig. 1—Effect of various amounts of alloying elements on Rockwell "B" hardness values of malleable iron.

TABLE 2—STANDARD ERRORS OF REGRESSION COEFFICIENTS OF TENSILE STRENGTH (PSI/1 PER CENT)

Group	A	B	C	D	Avg.*
C, per cent	2.50–2.52	2.53–2.55	2.56–2.58	2.49–2.51	
Days, no.	52	71	84	59	
Si	7432	5746	7284	10183	4719
Mn	7824	7540	5489	5242	3932
P	4910	9466	12496	16390	7277
S	21097	18262	6122	23919	10523
Cr	46594	36366	20076	15222	16170

* Computed as 1/3 the square root of the sum of the squares of the standard error for each group and representing the standard error of the averages of Table 1. NOT the average of the standard errors of the averages of Table 1.

TABLE 3—REGRESSION COEFFICIENTS OF ELONGATION ON CONCENTRATION (PER CENT/PER CENT)

Group	A	B	C	D	Avg.*
C, per cent	2.50–2.52	2.53–2.55	2.56–2.58	2.49–2.51	
Days, no.	52	71	84	59	
Si	−5.47	−1.65	+3.40	−2.11	−0.76
Mn	+6.95	+4.38	+0.17	−0.43	+1.80
P	+1.10	−3.29	+2.17	+11.1	+2.77
S	+32.8	−2.15	−6.77	+11.65	+6.73
Cr	+18.0	+14.6	−0.65	−21.7	−2.01

* See footnote of Table 2.

TABLE 4—STANDARD ERRORS OF REGRESSION COEFFICIENTS OF ELONGATION (PER CENT/PER CENT)

Group	A	B	C	D	Avg.*
C, per cent	2.50–2.52	2.53–2.55	2.56–2.58	2.49–2.51	
Days, no.	52	71	84	59	
Si	4.77	4.46	2.49	9.86	3.72
Mn	5.54	6.81	3.02	4.99	2.71
P	3.23	8.97	3.34	15.79	5.76
S	14.94	16.49	3.37	10.10	6.72
Cr	30.58	30.76	22.72	14.53	13.6

* See footnote of Table 2.

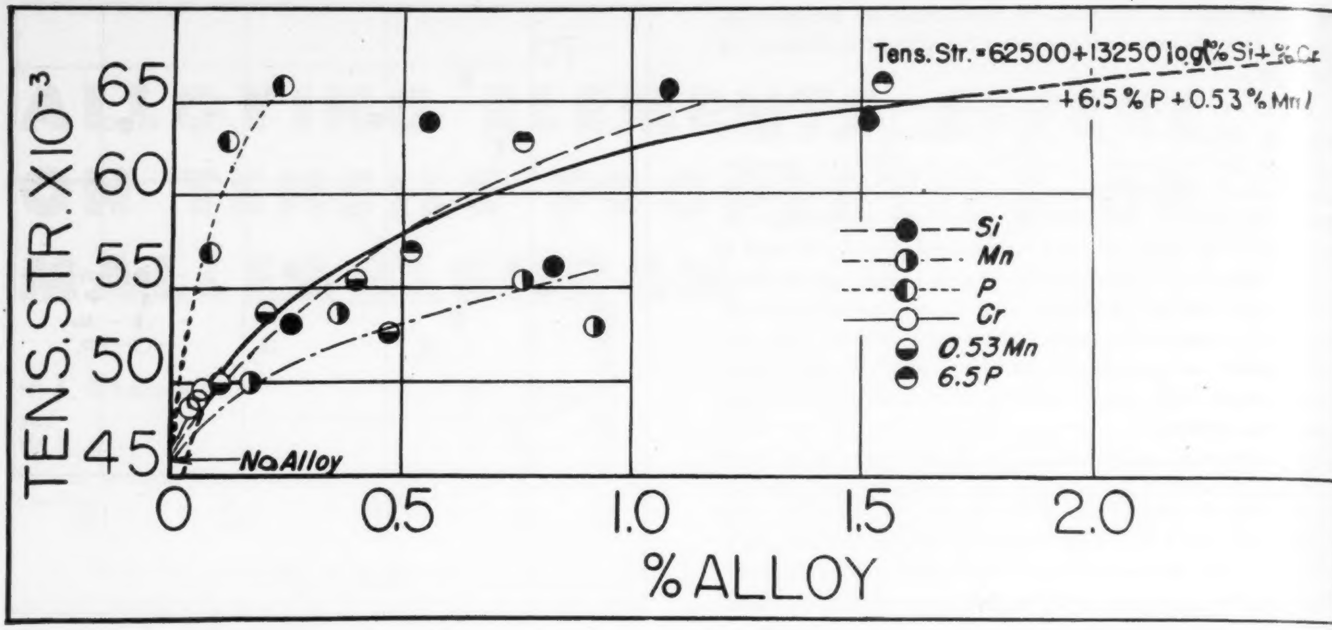

Fig. 2—Malleable iron tensile strength curves showing effect of various percentages of alloying elements.

several alloying elements separately. It is entirely reasonable that all four elements, when dissolved in ferrite, should strengthen the latter, and hence malleable iron. The present experiments were conducted to obtain some direct confirmation of this assumption in somewhat quantitative terms.

Armco iron was melted in vacuo in zircofrax crucibles with suitable amounts of ferrophosphorus, pure manganese, pure chromium or ferrosilicon to give alloys of the desired chemical composition. The melts were allowed to solidify in vacuo and were found to freeze with very large grains, some almost 1 cm in diameter. By quenching from above their A_3 points and renormalizing from above A_3, they were given a (ferrite) grain size comparable with that of malleable iron. The ingots were about 3/4 in. in diameter and the heights ranged from one to one and one-half in.

Rockwell "B" hardness was determined at numerous points on several cross sections of each small ingot and the results averaged.

In Fig. 1 these Rockwell "B" numbers are plotted as a function of the alloy content. It is reasonable, since the effect of a unit of any elements depends on the amount present, that the effect of two or more alloys was probably not directly additive. As a check on this an alloy was made containing 0.86 per cent silicon and 0.111 per cent phosphorus, which alloy had a Rockwell "B" number of 76.

In the phosphorus curve of Fig. 1 at 0.111 per cent phosphorus will be found a Rockwell "B" number of about 59, which is equivalent to a silicon content of about 0.7 per cent. Adding this silicon content to the observed value of 0.86 gives a total of approximately 1.56 per cent. The extrapolated silicon curve at this value shows a hardness of about 73. It appears, therefore ,that this means of summing the effect of more than one alloy yields results about as concrete as the curves.

As a check on the relation of Rockwell "B" to Knoop hardness, four of the alloys in Fig. 1 were tested on the Tukon hardness tester with the results shown in Table 6.

The results shown in Table 6 scatter rather badly but are roughly equivalent to the statement that the Knoop hardness is equal numerically to one and one half times the Rockwell "B" hardness plus 85.

Assuming that a malleable iron contained 0.15 per cent phosphorus, 1.00 per cent silicon, 0.25 per cent manganese (in excess of manganese sulphide) and 0.03 per cent chromium, this is equivalent to about 2.08 per cent silicon by the calculation made in the foregoing. At 2.08 per cent silicon, extrapolating the silicon line of Fig. 1, should give about 78 Rockwell "B" hardness, which by the equation correlating Rockwell and Knoop numbers should be something over 200. The Knoop numbers of the ferrite of malleable iron range from 220 to 250, which seems a fair agreement with the present work. These hardness values were converted

TABLE 5—MEAN COMPOSITION AND ITS STANDARD DEVIATION

Group	A	B	C	D
C, per cent	2.50–2.52	2.53–2.55	2.55–2.58	2.49–2.51
Si, per cent	0.99	0.99	0.98	1.08
σ Si, per cent	0.041	0.041	0.037	0.029
Mn, per cent	0.51	0.51	0.44	0.37
σ Mn, per cent	0.053	0.054	0.025	0.054
P, per cent	0.119	0.116	0.150	0.125
σ P, per cent	0.056	0.0181	0.0232	0.0169
S, per cent	0.174	0.173	0.156	0.098
σ S, per cent	0.0214	0.0239	0.0239	0.0118
Cr, per cent	0.035	0.036	0.031	0.027
σ Cr, per cent	0.0059	0.0050	0.0108	0.0181

TABLE 6—TUKON HARDNESS OF FERRITE

Heat	Alloy	Rockwell "B"	Knoop
2	None	30.5	135
7	1.42% Si	64.8	187
9	0.24% P	68.9	182
12	0.78% Mn	50.9	142
20	0.06% Cr	39.3	158

to tensile strengths by the data of Fig. 98 of Williams' "Hardness and Hardness Measurements. It may perhaps be argued that this conversion is not too reliable. The data are given in Fig. 2.

The slopes of the curves at 0.15 per cent phosphorus, 1.0 per cent silicon, 0.25 per cent manganese and 0.06 per cent chromium, approximate values in malleable iron, were measured and found to represent an increase of 47,500, 7,500, 12,500 and 32,500 psi for an increase of one per cent in the several elements in that order. All values are somewhat lower than those given in Bain's "Alloying Elements in Steel," Fig. 40.

It should also be noted that all of these values are higher than those approximated in the deductive approach. The latter fact is perhaps best explained by the idea that the present figures relate to the properties of approximately pure iron alloys, while the former relates to the effect of each element in the presence of the average amount of the three others (and perhaps of sulphur).

Consulting Fig. 2 it is found that 0.15 per cent phosphorus (a usual value) is equal in strengthening effect to 0.88 per cent silicon; 0.25 per cent manganese (a probable excess above sulphur) is equal to 0.17 per cent silicon, and 0.05 per cent chromium to 0.09 per cent silicon. Hence a 1 per cent silicon ferrite containing these amounts of other alloys might be equivalent to 2.14 per cent silicon and no other alloy where the curve would be much flatter. The general trend line of Fig. 2 has only empirical significance. It has been seen that the hardness of a ternary silicon-phosphorus-iron alloy bore out this idea.

Here is experimental support for the assumption that silicon strengthens ferrite. If it nevertheless weakens malleable iron, this is an indication that silicon affects the form of graphite nodules.

It seems a reasonable assumption that a given change in composition will produce the same proportional change in ferrite and in malleable iron. Ferrites average perhaps 15 per cent greater strength than malleable iron, so that the effect of changes of composition on malleable iron should be about 85 per cent of the values given (in psi).

The survey made has not been sufficiently extended to attempt an extrapolation from the data on ferrite into the region of complex compositions corresponding to the ferrites of malleable iron to justify a comparison on a quantitative basis with the values reached by deduction.

Conclusions

Based upon the foregoing discussion, the authors consider the following conclusions to be justified.

All the alloying elements strengthen the matrix of malleable iron.

Silicon probably increases the sprawliness of graphite sufficiently to overbalance its strengthening effect on the matrix.

The effect of a unit of any alloy decreases progressively as the amount of that alloy increases.

The cumulative effect of all the alloys can be approximated by converting the several concentrations into an equivalent amount of a single alloy.

Very roughly for such conversion, silicon and chromium are of equal potency, phosphorus is equivalent to about six and one half times as much silicon, and a unit of manganese to about one half a unit of silicon.

Changes in concentration in a metal containing as much alloy constituent as malleable iron cannot be expected to produce great changes in strength.

Acknowledgment

The authors wish to express their appreciation to J. V. Emmons, Cleveland Twist Drill Co., for providing facilities for making the Tukon hardness tests, and to J.V. Anthony, of this laboratory, for the calculations.

Schwartz to Give Tenth IBF Lecture

DR. H. A. SCHWARTZ, DIRECTOR OF RESEARCH, National Malleable & Steel Castings Co., Cleveland, will deliver the tenth Edward Williams Lecture of the Institute of British Foundrymen in London on June 9. His lecture "Solved and Unsolved Problems in the Metallurgy of Blackheart Malleable," will be given in response to an invitation from Tom Makemson, secretary, acting on behalf of the Council of the IBF. At the 1939 conference of the organization in London, Dr. Schwartz received the E. J. Fox Medal, the only time it has been awarded to anyone not a British subject.

British Institute of Metals Honors International Nickel Co. President

THE DISCOVERER OF MONEL METAL, Robert Crooks Stanley, chairman and president of the International Nickel Co. of Canada, Ltd., was last month awarded the 1948 (Platinum) Medal of the Institute of Metals (British). Simultaneously, it was announced that Sir Arthur John Griffiths Smouth, Imperial Chemical Industries, Ltd., has been elected Institute president.

American-born, Mr. Stanley was educated at Stevens Institute of Technology and Columbia University. With International Nickel Co. since 1902, he developed a process for producing monel, the white alloy of nickel and copper, direct from ore without separation in 1905. He was elected a director of International Nickel in 1917, vice-president in 1918, president in 1922, and chairman of the board in 1937. Mr. Stanley's leadership has made International Nickel one of world's outstanding mining and metallurgical enterprises. As president, he formed the development and research division of the company.

Mr. Stanley's achievements in the nickel industry have brought him the Thomas Egleston medal of the Columbia Engineering Schools Alumni Association, the first gold medal of the Rand Foundation, American Institute of Mining and Metallurgical Engineers, and the American Society for Metal's medal for the advancement of research. In 1937 the King of Belgium conferred upon him the Order of Leopold. In September 1947 Mr. Stanley was awarded the King's Medal for Service in the Cause of Freedom, instituted by King George in 1945. He has also been awarded an Sc. D. by Columbia, and the D. Eng. degree by Stevens Institute and Rensselaer Polytechnic Institute.

Sir Arthur Smouth, newly-elected Institute president, first entered the metallurgical field in 1905 as an apprentice with England's Elliott Group of metal companies. When that group became part of Imperial Chemical Industries in 1926, Sir Arthur became an executive of the parent organization, managing director in 1934, and was chairman of ICI's metals division from 1934 to 1942.

NEW CENTRIFUGAL PROCESS PRODUCES SOIL PIPE

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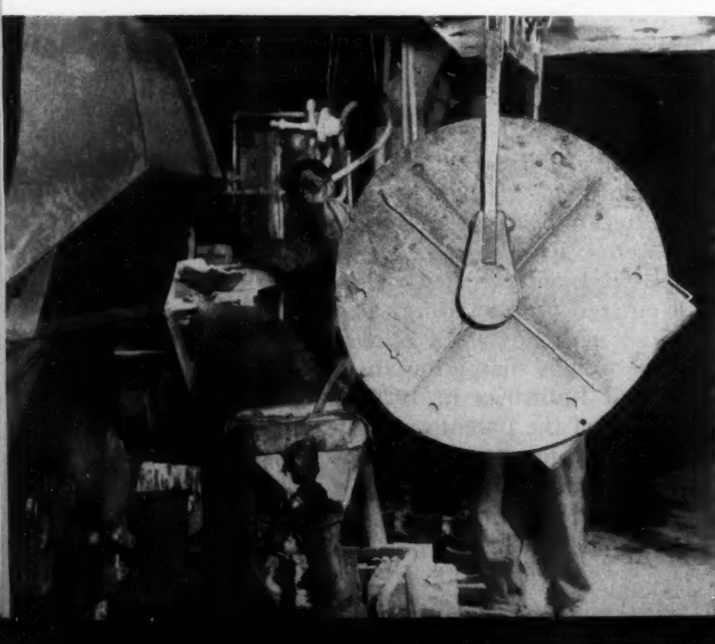
MANUFACTURE OF PIPE by the centrifugal process is by no means new. Prior to the turn of the century the literature recounts the experience of an energetic foundryman who made a sand-lined mold in a cylindrical flask, poured iron into the mold and then allowed the mold to roll down a ramp built into a hillside. When the mold reached the bottom of the hill he had a pipe, provided he could find the mold. Since that time there have been tremendous developments in the production of centrifugally cast pressure pipe.

Most foundrymen are familiar with the splendid developments which have been made along these lines in both the sand spun process and the de Lavaud process. Both of these processes are quite successful on certain types of cast iron pressure pipe, but to the author's knowledge are not used in the manufacture of cast iron soil pipe in this country. A review of the records of the U. S. Patent Office is quite impressive as to the amount of work that has been done in centrifugal casting of pipe and tubular products.

In the development of the patented process covered by this article, the foundry with which the author is associated was confronted with the problem of finding a permanent mold method that would produce pipe with a protrusion on both ends. This was a necessity due to the fact that approximately one-third of all the soil pipe sold is double-hub pipe. It was also necessary because the specifications for soil pipe do not permit the use of a pipe that does not have a bead on the spigot end. These requirements eliminated further consideration of the single piece permanent mold, as it would be impossible to withdraw the pipe from the mold after casting.

Fig. 1—Transferring molten iron from bull ladle to centrifugal casting machine ladle.



With the foregoing requirements in mind, a cast iron mold split longitudinally was employed, the two halves of the mold being fitted with a joint that would prevent iron from leaking through the mold.

The split mold had been tried before in England and Germany, but the author has been unable to find any references to its actual use in the production of pipe. From here on it was necessary to chart a new course, as there was nowhere to turn for definite information as to the practicability of producing pipe in a split mold.

Process Described

After years of research and experimentation, the foundry was able to develop a split permanent metal mold process which produces a good quality of pipe without subsequent heat treating, and at an extremely high rate of production. It was discovered that if the pipe was removed from the mold as soon as it had solidified sufficiently to hold its shape, a primary metallographic structure containing a pearlitic matrix and with the remaining carbon in a preferred form of graphite was obtained without the necessity of annealing the pipe, thus reducing the cost of the pipe made by the centrifugal process.

The casting machine used has a closed mold circuit. There is a service rack at the opening and closing side of the machine. Immediately over the machine is a mold rack where the mold from the previous cast is placed after clamping is completed. Originally an inert dry powder was used to protect the mold, but this was replaced by a water suspension of the powder because of ease and uniformity of application. The interior of the mold is sprayed with a water suspension of non-metallic particles while on the overhead mold rack. After spraying, the hub cores are set and pinned into the mold. At the far end of the overhead rack the molds enter a lowering device which takes them to the entrance side of the machine.

The actual mold spinning mechanism consists of two horizontal power-driven shafts parallel to each other,

NOTE: Presented at the Sixteenth Annual Foundry Practice Conference, American Foundrymen's Association, Birmingham District Chapter, in Birmingham, Feb. 12-14, 1948.

each shaft having two grooved rollers set approximately $3\frac{1}{2}$ ft apart, and with the rollers on the two shafts opposite each other. In the spinning and pouring operation a mold is cradled between these mold driving rollers. Both shafts are driven by a single motor using "V" belts. Between the driving rollers is a hydraulic lift which contacts the rollers on the mold and facilitates the removal of the mold after pouring. Rotary motion of the mold also helps carry it to the opening and pipe extracting station.

A precision pouring mechanism is placed at the front of the machine and meters the iron into the mold in such a manner as to uniformly distribute the molten metal over the entire length of the mold. This pouring procedure differs considerably from those commonly employed by the centrifugal casting processes for the production of cast iron pressure pipe in this country. The de Lavaud process uses a retracting pouring mechanism to uniformly distribute the molten iron into the water-cooled mold. The sand spun process rotates the mold at a low speed during pouring to obtain uniform distribution of the molten metal, then increases the speed of the mold to form the pipe.

The pouring method followed in this foundry is the use of a special form of ladle which is tilted by a hydraulic device which progressively decreases the velocity with which the iron enters the mold, while maintaining a pouring rate according to which a constant quantity of iron enters the mold for each increment of time during the pouring operations in such a manner as to provide uniform distribution of the molten iron in the mold. The mold is rotated at a constant speed during the entire spinning operation.

As a safety precaution, a fabricated steel hood of the butterfly or flap type covers the mold during the spinning operation. The flaps of this hood are actuated by a hydraulic cylinder.

Several molds are used on each machine at all times. The number of molds used in the circuit varies from eight to three, depending on the production rate of the machine and the size and weight of the particular pipe being made. The mold temperature plays an important part in this process.

It is preferable to hold the temperature of the molds to approximately 800 F. This is accomplished by taking advantage of the heat imparted to the mold from the

Fig. 2—Pouring a pipe casting on centrifugal casting machine. Note piled dry sand hub cores and extra molds on overhead rack.

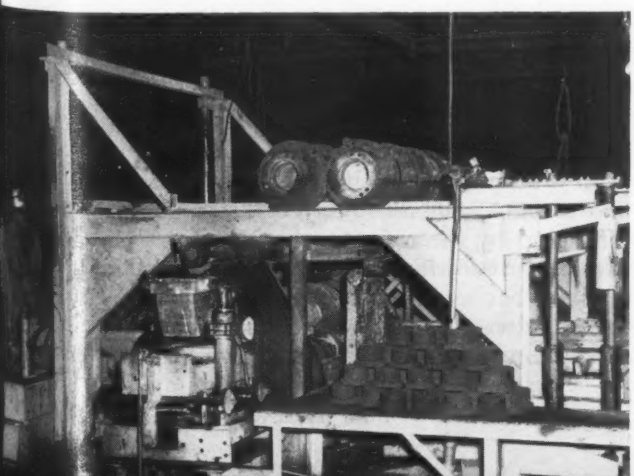


Fig. 3—Front view of centrifugal casting machine showing mold opening and closing station.

molten iron during the casting operation, and correlating this heat with the time cycle of the machine. These factors together determine the number of molds required on each centrifugal casting machine. This arrangement enables removal of a mold from the machine, for repairs or replacement, without stopping production on the machine.

A 4-in. soil pipe mold weighs approximately 1,000 lb. The inside diameter is about $4\frac{1}{2}$ in. and the outside about $8\frac{1}{2}$ in. except at the roller sections where it is 15 in. It must be machined so that the inside is concentric with the outside. The mold is split on the center line and diametrical alignment is maintained by a stepped joint. A dowel pin in one half assures matching longitudinally. All molds with clamps are balanced by use of an especially designed balancing machine before they are put into the production line.

Molds used on the production machines are made from plain cast iron. After experimenting with several hundreds of alloyed cast iron molds of various compositions, none was found superior to plain cast iron, price considered. The important factors governing mold life are: (1) a sound casting free from strains; (2) service temperature; (3) abuse in service, and (4) the mold coating. Mold coating is used to protect the mold from the erosive action of the iron and to prevent sticking of the pipe in the mold. Average mold life ranges between 2,000 and 3,000 pipe. Some molds last longer, while some that have been plainly abused or had a casting defect fall considerably below the average. The best average performance comes with a steady and high rate of production.

The mold clamping device is another important factor of the process. Each mold is fitted with four 2-piece hinged clamps, which are fastened together by four interconnected hydraulic cylinders which apply their force in tension simultaneously to the two halves of the clamps by the use of four "U" shaped bails. Water at approximately 2,000-lb pressure is applied to these hydraulic cylinders through a flexible hose fitted with rapid connecting nipples.

A high pressure and a low pressure hose is fitted in each hydraulic cylinder. The low pressure is used to

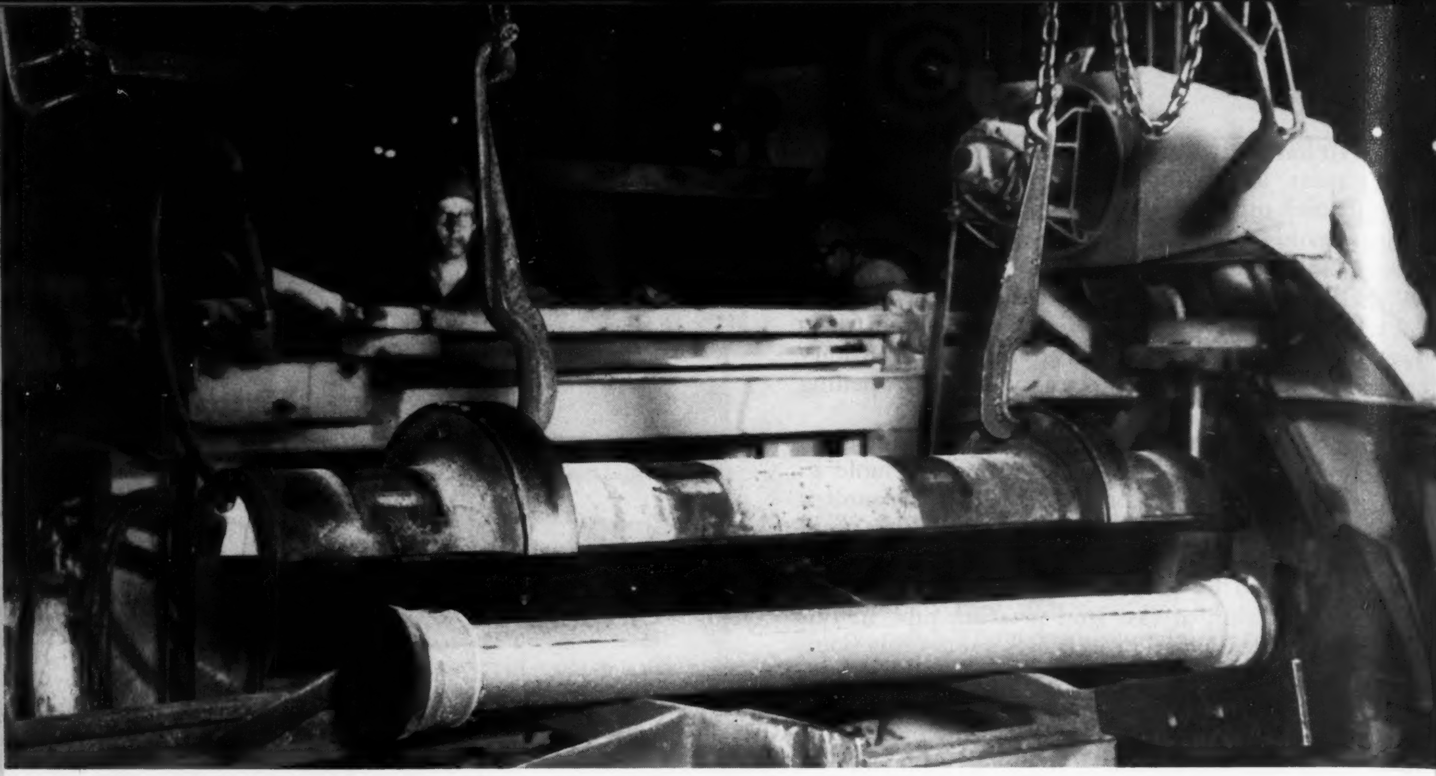


Fig. 4—Centrifugal cast soil pipe as removed from cope half of split mold made of unalloyed cast iron.

unclamp the mold and the high pressure is used to hold the mold together during the spinning operation. Upon closing the mold and applying the 2,000-lb hydraulic pressure to the clamping cylinders, the pressure is then locked into the cylinders through the use of a valve. The mold is then ready for spraying inside with the coating, setting cores, and placing in casting position. The mold is rotated at a speed equivalent to 40 times gravity, and the iron poured into the mold. The hot mold heats the clamping cylinders, thereby causing a thermal expansion of the water and, at proper temperature and pressure, forms steam which increases the clamping pressure and gives maximum clamping action when most needed.

Elapsed time from clamping a mold to extracting a pipe from the mold is 45 sec or less. The foundry now

PHYSICAL PROPERTIES OF STATIC SAND CAST AND CENTRIFUGALLY CAST SOIL PIPE

Test	Static Sand Cast, 4 in.	Centrifugally Cast, 4 in.
Average Wall Thickness, in. . . .	0.24	0.26
Wall Thickness Variation, in. . .	0.073	0.036
Bursting Pressure, lb	2,100	2,220
Bursting Tensile Strength, psi .	16,270	22,000
Ring Crushing		
Modulus Rupture, psi	67,033	61,000
Modulus Elasticity, psi	18,400,000	14,700,000
Talbot Strip		
Modulus Rupture, psi	58,406	50,200
Modulus Elasticity, psi	11,200,000	12,300,000
Rockwell "B" Hardness	84-92	82-96

Chemical Composition, per cent	
Total Carbon	3.40-3.60
Silicon	1.90-2.20
Phosphorus	0.90 max
Manganese	0.50-0.60
Sulphur	0.110 max

has eight production machines in operation for manufacturing soil pipe. The machines are located on 17½-ft centers. Each machine produces an average of 400 pipe per 8-hr shift, and as many as 523 pipe have been made on one machine in 7½ hr.

During the developmental stages of this process considerable research work was done on mold speeds, pouring rates, mold compositions, mold coatings, mold temperatures, iron compositions, iron temperatures and physical properties of the product. All factors were carefully considered and the best result set up as standard for the process.

On the production line all important factors influencing the quality of the product are constantly checked through a quality control system. These factors include iron temperature, iron composition, mold temperature, physical properties of coating, wall thickness of pipe, weight of pipe, shore hardness, and quality of the hub core. The process has not been found to require exacting control on such things as iron temperature, but it has been found advantageous to stay within established limits on all important factors to insure a good quality product at the lowest cost.

Physical Properties

Physical properties of the soil pipe produced by this process are well within all of the specifications for the product. As a matter of interest, the average physical properties and range in chemical analysis of pipe made by both this process and the conventional static sand-cast process are shown in tabular form. The test data show that the product made by the centrifugal process is comparable to sand-cast pipe, and that it has physical properties equal to that of pressure pipe.

This foundry has been making pipe by the centrifugal process for more than two years. During this time more than 2,000,000 5-ft lengths of pipe have been produced by the centrifugal method described in the paper. In addition to increasing production, the new method has served to better the morale of employees by improving working conditions and making the foundry a more desirable place in which to work.

COKE BOOSTERS

A FALLACY IN CUPOLA OPERATION?

In this day of material shortages and poor quality many foundrymen are seeking expedients that will supply the type of iron needed at a rate commensurate with the molding operations. One of the greatly misused expedients is the coke booster charge. The purpose of this article is to portray its use and misuse.

For example, consider a typical foundry producing one type of iron in the cupola, to cast automotive parts containing 3.25-3.45 per cent total carbon and 2.10-2.30 per cent silicon. Table 1 shows the coke charging record.

Assuming that the proprietary carburizer is equivalent to an equal weight of coke, in terms of carbon, it is first noted that three carbon ratios exist during the heat. Also note that additional coke has been charged into the cupola between the after coke charges. Table 2 is a record of the booster charges.

Table 2 indicates that 9.3 per cent of the total coke charged during the heat was in the form of booster charges. Fig. 1 shows the coke charging record graphically in terms of the coke charged per hour. The broken line indicates the coke charge per hour as after charge coke, while the solid line indicates the total coke charged per hour. The average metal to coke ratio computed on the basis of the after charge coke was 6.34:1 while the true ratio was 5.76:1. The analyses of the iron that accompanies this charging record are shown in Fig. 2. A reduction in total carbon is noted at 9:00 am, and a substantial carbon increase is noted at 6:00-7:00 pm. Referring again to Fig. 1, it can be observed that the analyses closely follow the coke charging chart. Thus, the booster added at 7:00 am did not increase the bed sufficiently to compensate for the smaller after coke charges that were used at the beginning of the heat. The booster charge at 10:00 am was not adequate and did not rectify the lower total carbon after the lunch period. Nearing the end of the heat, a gradual reduction in the coke charged is reflected by an accompanying decrease in total carbon. The outstanding behavior in this cupola operation is the variation in bed height, resulting in a variation in the analysis of the molten metal.

Why Use Booster Charges

In support of these conclusions, the cupola operator was asked why the booster charges were used and the following reply was received:

1. The total carbon always decreases to below specification during the third hour; therefore, additional coke is necessary to prevent the decrease.
2. Shrinks increased and the operator attributed this to iron containing less total carbon.
3. A booster charge is always used before a shutdown period to prevent the bed from burning down.

This paper is the second of a series, dealing with modern cupola operation, sponsored by the Cupola Research Committee of A.F.A. Other reports will appear in future issues of American Foundryman.

Other foundrymen would probably add the following reasons for using booster charges:

1. The bed height in the cupola was low; hence, additional coke was necessary to replenish the bed.
2. Chill depth of the iron has increased, thus pouring and machining troubles are anticipated. A somewhat higher carbon would help reduce the chill depth of the iron at the same silicon level.
3. Metal temperature decreased, even though the same weight of air was introduced into the windbox.

Any one or all of the reasons are legitimate, but at least five of them indicate poor cupola operation. All but Point 3 in the first group indicate irregularities in bed height (the distance from the top of the tuyeres to the top of the coke). Point 3 in the first group is considered good operation. Fundamentally this height should be maintained uniformly throughout the heat for a uniform iron composition.

The coke bed height influences the following:

1. Metal temperature at the cupola spout.
2. Melting rate per hour (total tons of metal charged

Table 1—Coke Charging Record

Coke Charges, Nos.	Coke Weight, lb	Proprietary Carburizer, lb
1-6	380	0
7-10	400	0
11-84	360	40
85-91	325	0

Table 2—Booster Charges of Coke

Time	Coke Charged, lb
7:00 am	400
10:00	400
1:15 pm	500
1:45	500
2:15	500
3:35	500
4:45	500
6:30	500
9:30	500

Note: Lunch, 11:20 am-12:00 noon; shift change 3:00 pm-3:30 pm; second shift lunch, 8:00 pm-8:30 pm.

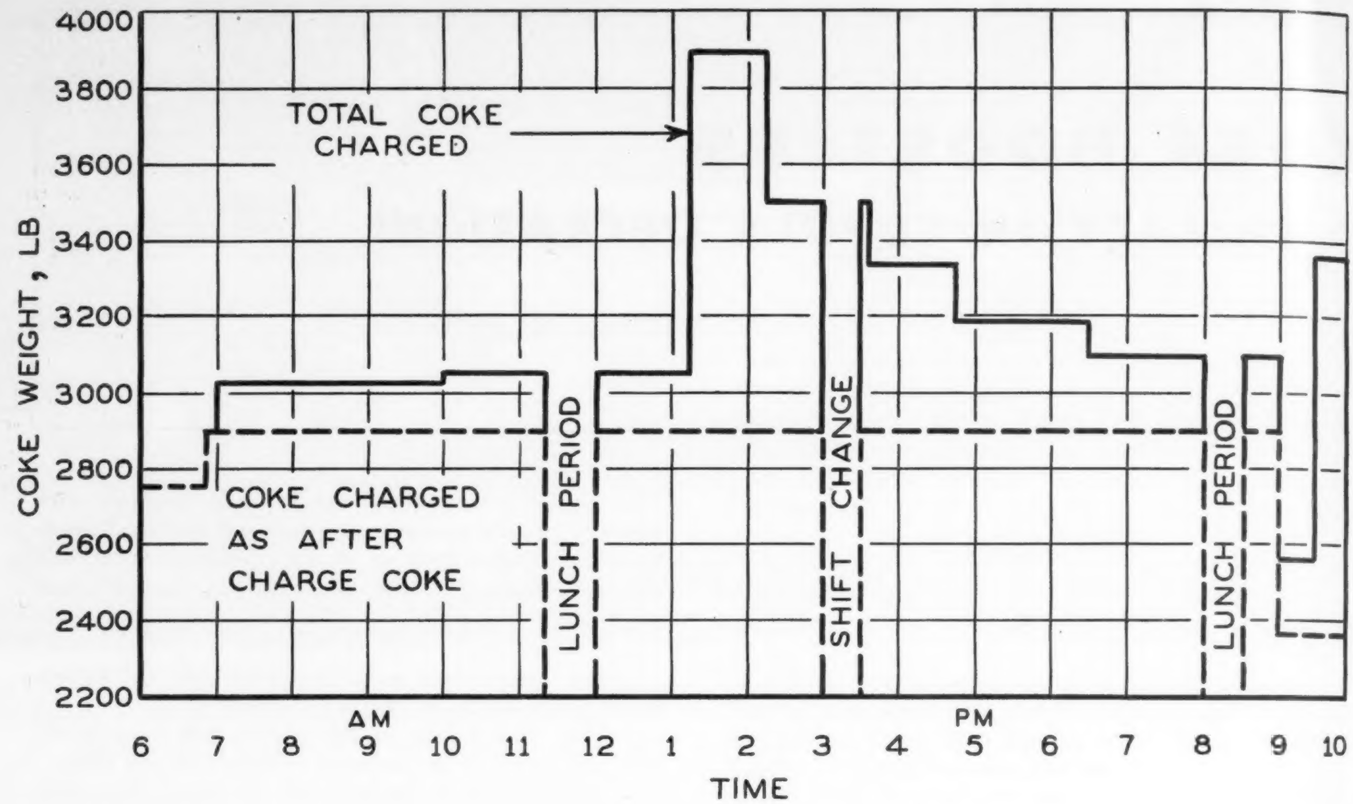


Fig. 1—Coke charging record (coke charged per hour).

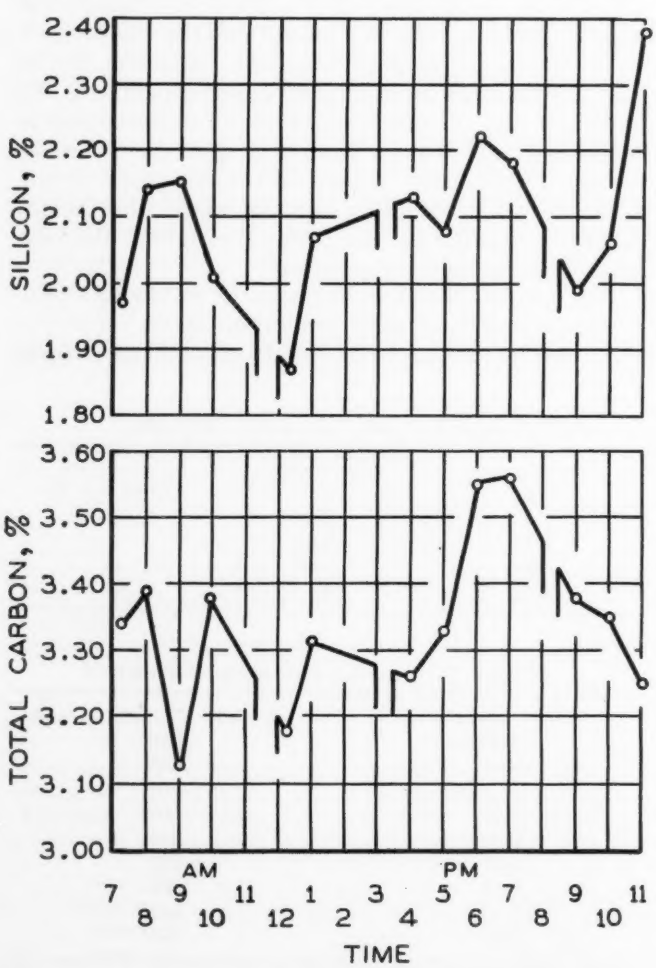


Fig. 2—Iron analyses curves (see charging record, Fig. 1).

in cupola divided by the total melting time in hours).

3. Carbon content (determined by an analysis for total carbon, combined carbon and graphitic carbon).

4. Appearance of first metal (indicated by the time that has elapsed from the time the air blast was put on until a steady stream of metal flows from the tap hole).

Since these factors are controlled by the height of the bed, the cupola operator should give it particular attention. Coke quality at present is not equal to prewar standards, nor is it of uniform quality, and hence the bed may be consumed more rapidly or slowly than anticipated. Frequent observation of the behavior of the cupola is necessary because of these variations in the behavior of the coke. In a foundry receiving what may be considered good coke today the carbon content of the coke varied from 88.96-95.20 per cent during one week. This is a 6.24 per cent variation, or 6¼ lb of carbon for every 100 lb of coke charged. This may not appear to be a significant amount, but over a period of a few hours its effects may be observed.

The operation described would have been improved if the booster charges were spread equally over all the after charges, and the booster charge prior to lunch had been increased. After reviewing the problem with the operator, the foregoing recommendation was tried. The result was a marked improvement in the uniformity of the total carbon and better overall cupola operation. The melting rate under the previous method of operation varied considerably, and the change resulted in a steadier flow of iron. It is the opinion of many foundrymen today that the cupola operator has to be satisfied with a lower melting rate, using presently available coke, if the quality of his iron is to be maintained.

In most foundries chemical analyses of the coke are not available, hence a change in coke ratio cannot be calculated. A method is employed by some operators

that seems satisfactory, providing sufficient coke can be made available. A pile of known good coke is held in reserve. When an unknown or new coke arrives, it is immediately segregated. To determine the effects of this coke on cupola operation, melting is begun with the known good coke. After 2 or 3 hr the coke charge is changed to half and half of new and known coke. If, after 2 hr, the operation still remains satisfactory the coke charges are made up entirely of the new coke. Its effect is again carefully observed. If no change is noted, the coke is classified as satisfactory coke and placed on the proper pile. On the other hand, if the coke gives poor results it remains segregated and is used where deviations in operation are permissible. Some operators use it as *part* of the after coke charge, but in amounts that will not alter the operation.

Until research develops a coke test that will indicate the changes necessary in cupola operation to accommodate variations in coke, the foundrymen will have to use approximate methods such as described to obtain quality iron. The A.F.A. Cupola Research Committee is working on this problem at the present time, and hopes to develop such a test during the course of its research program.

DOES METAL VAPOR CAUSE SAND PENETRATION?

Silas G. Jones
Pittsburgh

When a green sand mold containing a heavy sectioned casting breaks out at the bottom, at the time the metal is in the head or immediately after pouring, the following conditions will exhibit themselves: the casting will be nothing but a hollow shell and, most important, the sand will peel much more readily than from a solid casting, made in the same sand and of the same heat. The most pronounced difference will be in the pockets of the casting, where the hollow casting will contain little or no metal-penetrated sand, whereas the like solid casting will show much penetration in this pocket, these castings, of course, being in the same heat and sand condition. This condition indicates that metal penetration of sand takes place after a skin of metal has formed in the mold.

It is well known that all liquids have a vapor pressure, and that during solidification there is an escape of gas from the metal. In fact, gas continues to escape from metal at temperatures below the melting point. This leads the writer to believe that metal penetration of sand results from metal vapor or metal laden gas passing through the sand.

In substantiation of this belief, the following phenomena are rather common in a steel foundry making castings of this nature and process.

1. In a heavy-sectioned casting molded in a high moisture, dense sand, sprayed with a silica-compounded wash and skin dried, the following conditions will be observed. First the occurrence at various sections of the casting of a layer of metal-penetrated sand which is separated from the casting by the film of wash. Under certain conditions, this layer of metal-penetrated sand can be pried off with a chipping hammer. It will come off in small sheets. When this is done the wash from the mold remains on the casting.

Moisture Induces Penetration

The wash on the mold is dense and of low permeability. It is difficult to conceive of liquid metal flowing through this film of wash. If this same mold had been completely dried or baked, it would not exhibit any of these conditions. If this same casting had been made in a sand of lower moisture content and higher permeability, of the same formula, and a burn-off material used in the wash instead of water, the metal penetration would be greatly reduced or would disappear.

The reason for the occurrence of this layer of metal-penetrated sand is the condensation of the metal vapor or metal-laden gases induced by the moisture at a short distance from the surface of the mold. As this moisture is reduced the condensation is not as rapid. Greater distribution of metal vapor or metal-laden gases provides a greater opportunity for oxidation to take place, resulting in the absence of metal-penetrated sand.

2. In adding to this line of reasoning, it is also known that oxidized linseed oil and iron oxide will tend to reduce metal penetration. This phenomenon is nothing more than that the oxygen of these compounds oxidizes the metal vapor, changing this metal vapor to a slag easily separated from the casting.

3. All steel castings from which the sand is readily separated have a film of slag covering the entire casting.

4. It has also been shown, by test of the sand next to the casting, that an increase in iron oxide has taken place, and that this increase has taken place after a skin of metal has been formed in the mold.

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BELGIAN FOUNDRY PRODUCES WEAR-RESISTANT CAST IRON

G. Halbart
Manager
Les Fonderies Magotteaux
Vaux-Les-Liege
Belgium

Activities of Les Fonderies Magotteaux have always been limited to the production of hard cast irons and hypereutectoid steels for wear resistance. The manufacture of chilled cast iron has been a specialty of these foundries since 1914, and they have been turning out castings such as car and truck wheels, parts for ball and pan-mills, grinding media, etc.

Among the wearing parts manufactured by the author's foundry, it is worth mention that a large number were made—since 1938—in nickel alloy white cast iron containing 4.5 per cent nickel and 1.5 per cent chromium. This metal replaced chilled cast iron in many applications where abrasion was the main problem, and in which advantage could be taken of its very great hardness (BHN 650 to 700). Wherever higher resistance to shock was essential, various grades of martensitic gray cast iron were turned out on a large scale, the Brinell hardness being about 500.

The martensitic structure is obtained either in the heat-treatment of high strength gray cast irons, or in the production of self-hardening nickel cast iron. In most cases, a combination of the two affords the best and most economical results.

Mention should also be made of a pearlitic malleable cast iron, which is produced in various grades of hardness from BHN 200 to 300. The special heat treatment is carried out in city-gas-fired furnaces with automatic temperature control. The castings are not packed, which allows for a considerably shorter period of treatment. Completion of the cycle requires about 20 hr.

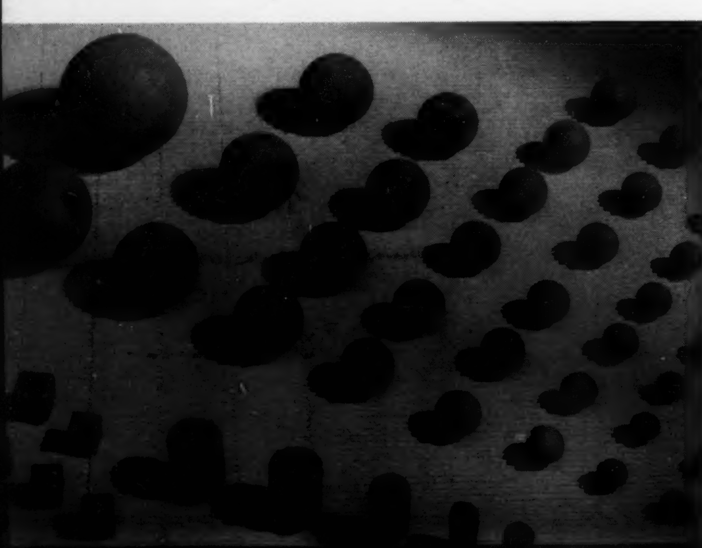
In speaking of the special difficulties encountered by a European foundry, it should also be noted that Belgium has been one of the main battlefields in two World wars within a quarter of a century. In the course of the latter, a flying bomb destroyed a very large part of the plant of Les Fonderies Magotteaux.

Notwithstanding these difficulties, or rather in an attempt to overcome them, these foundries, like many other European plants, are now endeavoring to assimilate the most recent developments of American industry. Perhaps here lies the only advantage of the Europeans, i.e., the possibility of seeing real examples of advanced industry, which allows them to hope to avoid the groping inherent to all progress.

The value of the American example, however, should not be overestimated, but should be adapted to the particular conditions prevailing in Europe, where not only are the markets not so important, the financial possibilities more restricted, but also where social conditions and possibilities of supply must be considered in solving the particular problems. One typical example is the acute shortage of coal, which factor is often prominent in the solutions chosen.

European economic structures are not always clear to the American industrialist. It is difficult for him to realize that the markets available to the European foundries are restricted, and that these foundries have had to cope with quite a comprehensive range of competitive manufactures. Morever, chilled cast iron wheels have never been adopted by the Belgian public railways.

Examples of grinding media—ball, cube, and cylinder forms—produced in special alloys for particular use.



View of a corner of the foundry refectory—one of the first projects in the company's modernization program.

In the particular plant concerned, as in many others in Europe, the technical staff has made a special effort to apply the "one plant, one product" principle, and is now beginning to reap the benefit of this policy which had been so seldom applied in Europe.

Drifting little by little away from the manufacture of a too comprehensive range of wearing parts, the works are now mainly turning out a superior quality of grinding media (grinding balls, cubes, cylpebs, etc.). A special alloy has been devised for this particular purpose. The composition of this alloy is adapted to the various particular cases which occur in this rather special branch. Its analysis alone, and especially its high carbon content, should cause it to be classified as cast iron; but on account of its micrographic structure and the heat-treatment it undergoes, it should rather be considered as steel.

It will be recollected that, in the same way, rolls are cast in steel containing up to 2.25 per cent of carbon, and that many high-speed steels, and particularly the well known 12–13 per cent chromium steels, because of their high carbon content, should be classified as special white cast iron, sometimes almost eutectic.

New Casting Alloys

In the past, it was common practice in Europe, to produce grinding balls and small grinding media in white or chilled cast iron. Little by little, this type of casting had been replaced by forged steel, on account of the spalling of the cast balls and the chipping and scaling of the small grinding media. In service, these parts are submitted not only to severe abrasion, but also to not too violent but repeated impacts. At the present time, the new casting alloys afford low cost grinding media of a superior quality.

After laborious research the ideal hardness for the grinding balls was estimated to be about Rockwell C 40. Through hammer-hardening, a hardness of Rockwell C 48 can be attained.

A difficult problem was the casting of the balls, because of the possible occurrence of shrinkage cavities and other foundry defects common with such castings. These difficulties have now been entirely overcome. The progress made in America during the war, thanks to a thorough study of atmospheric feeders, was of great value in this connection. It is believed that centrifugal castings would probably allow diminishing the weight of the gates and feeders, but it has not been possible to apply the method as yet.

The plant is equipped with cupolas, oil-fired rotary melting furnaces, and oil-fired furnaces for the heat-treatment of castings. Molding is done on American pneumatic machines. The molding flasks are of steel. Mechanization of the works has yet to be developed, but it is believed that the ever-increasing specialization of the plant will help progress in this direction, and that the growing scarcity of specialized labor will make it more and more necessary.

Right (top to bottom)—One of the oil-fired rotary melting furnace. A small gas-fired furnace, equipped with "surface combustion" burners and automatic temperature control, used for special heat treatment. Castings are not packed, and the treatment cycle is completed in about 20 hr. View of the main foundry floor.

CONTROLLING SAND GRAIN DISTRIBUTION REDUCES STEEL FOUNDRY COSTS

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American Colloid Co.
Chicago

STEEL WAS FIRST CAST in naturally bonded sands, and immense cleaning costs were incurred unless the molds were made in dry sand and with a suitable refractory coating. Little green sand was used, as clay in the naturally bonded sands had a low fusion point, and the sand required so much water to lubricate the grains that it was difficult to obtain a good casting with green sand. The nearest approach to green sand molding was the process of skin drying the mold after a molasses-water or a silica flour mold wash was applied and the surface dried with a torch.

When synthetic sands first appeared in the steel foundry they were coarse, nonuniform and very high in silica content. It was first thought that steel sands should be as open as possible to remove the enormous amount of gas created by such a high-temperature metal as steel. It was common for permeabilities to run 600-800, and the practice of using finer sands was frowned upon as unsafe. It was thought that if penetration occurred in the open sands, a certain amount of silica flour should be used to eliminate it.

Erroneously, it was believed that permeability would still be maintained. Some foundries incorporated such coarse sands that it was almost impossible to reduce the permeability with small percentages of silica flour, and it was like adding a handful of silica flour to a bag of marbles to decrease the permeability. The foundry industry has gradually reduced the amount of very coarse sands and standardized on grains between A.F.A. Fineness Nos. 50-70 for general work.

Sand Expansion

Coarse sands usually are quite uniform in grain size, and are accompanied by high sand expansion. The more uniform the sand grain and the higher the silica content of the mass, the greater the sand expansion. Sand expansion leads to scabs, buckles and rattails, and these defects are always aggravated by high temperatures. Figure 1 shows a coarse grade of steel foundry sand that has high sand expansion.

Figure 1 illustrates the sand on three adjacent screens, but it is so uniform that it possesses many wide pore spaces which encourage metal penetration. Such a sand dries out rapidly and is difficult to patch or work by hand after the pattern has been drawn. If such a sand is rammed too hard, sand expansion is increased and the common defects such as scabs and buckles occur.

Due to its openness, metal penetration and burn-ins are common with such sand. Many foundrymen believe that the condition is a result of fusion by the metal, whereas the actual condition is that the sand voids are filled by metal penetration. It is a mechanical function and results from pressure forcing the metal into the interstices or voids between the sand grains. The past popular cure to avoid burn-in or metal penetration from such sands was heavy doses of silica flour, which was expensive. High clay content must accompany such a sand in order to supply correct shrinkage to compensate for the sand expansion, but this also is expensive and unnecessary.

A finer sand distributed over five screens in proper order is the least expensive method. It eliminates the silica flour in part, or totally in many cases. Less clay may be added, which would reduce the green compression strength unless the sand used has proper grain distribution.

Mold washes are employed to help reduce burn-in or metal penetration, and mold washes are expensive. Finer and well distributed sand grains require less mold coating, and in some cases eliminate the coating entirely. Few arguments can be advanced for using coarse sands, but many arguments for not using them may be listed.

Three-Screen Sand

It has long been advocated that the proper sand to use is a three-screen sand, with the bulk of the sand grains on the center screen. Figure 2 illustrates such a sand, but again it must be pointed out that such a sand has high expansion and contributes to defects such as scabs, buckles and rattails. Much bonding clay, sea coal, wood flour or cereal must be used in conjunction with such sands to lessen sand expansion due to the very uniform sand grain distribution, which frequently is aggravated by the high silica content of washed and screened sands.

It is quite dangerous to ram such a sand hard unless the green compression strength is 10 psi or over, as defects may occur. Once a mold hardness of 60 is reached during ramming, anything beyond seems to aggravate sand expansion, which in turn aggravates scabs, buckles and rattails.

Base permeability of sand depends on the ratio of sizes, the shape, and the arrangement of the particles.

NOTE: This paper was presented at the Ohio Regional Foundry Conference, in Cleveland, March 11-12, 1948.

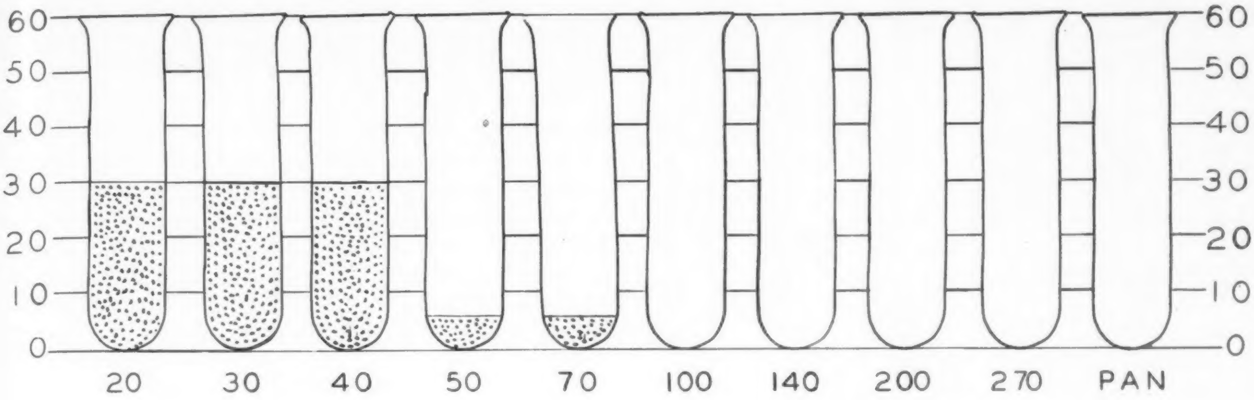

Fig. 1—Coarse grade of steel foundry sand of such uniformity that it is retained on three adjacent screens.

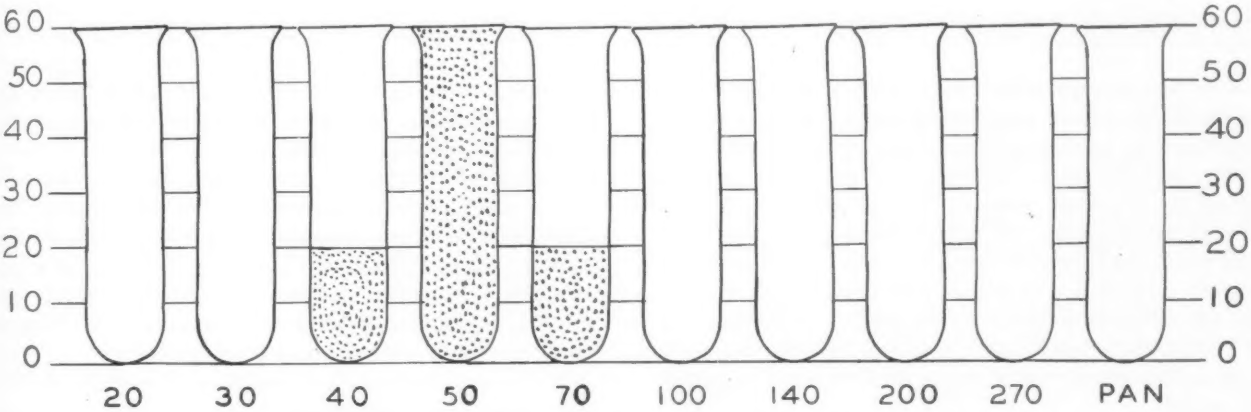

Fig. 2—Three-screen sand with bulk retained on center screen has high expansion and requires much bonding clay, sea coal, wood flour or cereal.

If the sand grains appear as spheres of equal diameter, the volume of pore space is about 48 per cent of the total volume of cubical piling, and only 26 per cent if the grain is hexagonal in shape.

Comparing selectively rated sands with sand having grains that are approximately of equal size, the latter requires more clay bond to fill the porous spaces. In the latter, shrinkage occurs until the large grains touch. After that the plastic portion of the mass continues to shrink between the grains and may crack in either drying or when the metal is poured into the mold. This increases the internal pore space and causes a rough exterior surface due to the projection of the silica grains, between which lie concave surfaces of the plastic bond. Such a condition may cause metal penetration or burn-in. Selective grading, or in terms of ceramic nomenclature, "grain sizing" or "proportioning of the nonplastic aggregate," seems to lend better physical properties to the system sand than the use of uniform sand mixtures.

With the bentonite or clay portion acting as a film on the sand surfaces, greatest density is obtained by selective grading, that is, using the greatest quantity of maximum-sized grains and filling the voids with the next smaller particles that do not crowd or elbow the largest grains out of their most compact arrangements.

Medium-sized sand grains should be the maximum for their position and, in turn, their void spaces filled with smaller particles, etc., until finally the size of the bonding agent is reached. A small percentage of fines does not condemn the sand; it is when the concentration of fines exceeds safe limits that trouble occurs. Common grading or screening of sand produces a gradation of sizes, each of which tends to elbow the next larger size out of its most compact arrangement, and some screened sands may be out of graded proportion when received.

The foregoing theory is given only to illustrate the tendency of progressive foundries toward a finer, more carefully graded and denser sand. It is proven that coarse sand and fine sand yields greater strength than intermediate-sized sand, and it is emphasized that the A.F.A. Fineness Number has little significance when comparing sands, as it is better practice to compare actual grain distribution.

Using Wood Flour With Cereal

By establishing proper sand control and controlling the grain distribution curve of the system sands, considerable savings can be made in the amount of silica flour, bonding material, wood flour, organics and other materials which are used in good molding practice.

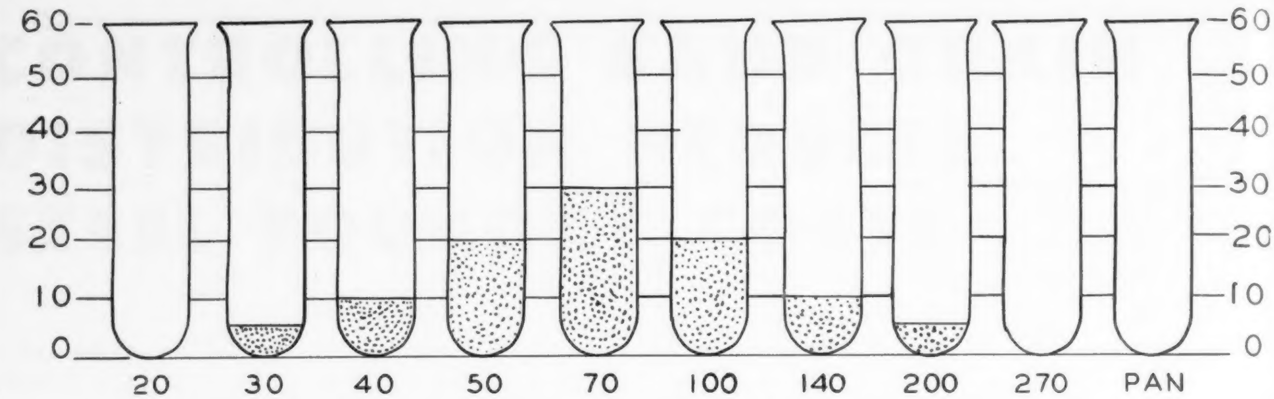

Fig. 3—Sand with proper grain distribution as shown in sketch does not require an excess amount of plastic material to neutralize sand expansion.

Coarse sands with high permeability and very uniform sands that have much pore space dry out easily. If bentonite is used as the bonding agent in the steel foundry, usually only 3-3.5 per cent moisture is used to lubricate the sand grains. Drying out of synthetic sand has always been of much concern to the steel foundrymen, and thus it was that cereal was introduced into steel mixtures to prevent mold friability. Coarse sands are difficult to patch, and much cereal must be used. High-expansion sands that are uniform usually have good flowability, unless the flowability is impeded with cereal.

Cereal is used to stiffen the sand or make it tough. It increases deformation and prevents ramming the sand too hard and getting it too dense, and tends to eliminate scabs and other defects common to high mold hardness. For these reasons, cereal has established itself in the steel foundry and is considered an essential ingredient of sand mixtures.

Recently, however, several steel foundries have been experimenting with mixtures of 50 per cent wood flour and 50 per cent cereal, and have found that the mixtures work better than either alone. In considering economy in the steel foundry, wood flour delivers at less than one-third the price of cereal, and can represent a substantial saving in the foundry by reducing the amount of cereal used.

Considerable discussion has arisen on the use of wood flour in the steel foundry, and many commercial wood flours are being offered. Fineness of grind is important in determining the wood flour selected for use with cereal, and for best results it is found that at present no more than 2 per cent residue should remain on an 80-mesh screen. This type of wood flour gives the properties shown in the table.

Certain wood flours are ground practically as fine as the average cereal. Present users claim fewer scabs when incorporating wood flour in the mixture with cereal than when cereal was used alone.

Wood flour is not as gummy and sticky as cereal, and therefore imparts better flowability to the sand, thus giving a harder rammed mold and assurance against fewer scabs and buckles. Wood flour sands do not dry out as rapidly as cereal bonded sands, but on the other hand cereal bonded sands give a better mold skin hardness. A combination of wood flour and cereal provides the advantages of each.

The rapid reducing atmosphere which wood flour offers when metal is poured aids in the peeling of the castings, and fewer oxidizing defects occur in the mold cavity. Easier shakeout accounts for fewer cracked castings and lower sand loss when wood flour is added to sand mixtures. Casting finish seems to be improved and the castings peel quite freely.

Periodic scarcity and the high market price of cereals have lead many foundries to investigate the possibilities of the finely ground wood flours, and many have learned that cereal use can be reduced and in many cases entirely replaced by proper additions of wood flour and controlled green compression strength. A real economy in the foundry is obtained if the correct ratio of cereal and wood flour can be found with additions of bond to foundry mixes.

Most foundries feel that green compression strengths greater than 8 psi are unnecessary, but usually these plants have proper sand grain distribution similar to that shown in Fig. 3, and such sand does not require an excess amount of plastic material to neutralize sand expansion. It is felt that if the steel foundry would study grain distribution of the sand, less bonding material would be required in the foundry. Less bonding

Effect of Wood Flour Additions

Properties	In Cores	In Green Sand
Green Permeability	Reduced	Reduced
Baked Permeability	Reduced	————
Green Compression	Slightly Increased	Greatly Increased
Core Hardness	Slightly Lower	————
Mold Hardness	————	Same, or Higher
Baked Tensile	Reduced	————
Dry Strength	————	Reduced
Flowability	Same, or Higher	Same, or Higher
Hot Strength	Greatly Reduced	Greatly Reduced
Moisture	Increased	Increased
Deformation	————	Increased
Volume Change	Greatly Reduced	Greatly Reduced
Atmosphere	Reducing	Reducing
Density	Increased	Increased

material added means less cost, and the control of the molding sand would be compensated for by better castings and a higher quality product.

Not many steel foundries have investigated the use of southern bentonite (Fig. 4) in backing sands, but backing sand can be rebonded with southern bentonite to advantage. The reason for the addition of southern bentonite to a backing sand is to obtain better collapsibility, and less cleaning and shakeout expense. Southern bentonite has low dry and hot compression strengths and it is thus ideal for the job. One steel plant rebonds backing sand with southern bentonite to avoid lumpy sand conditions after the heat has penetrated the mold, and thus saves on shakeout labor.

Increasing Collapsibility

In dry sand work, southern bentonite may be used to increase the collapsibility of the mold or core. Better flowability is given the sand when a certain percentage of southern bentonite is used in conjunction with western bentonite, which means better and more even ramming throughout the mold. Labor is saved at the machine by using a few cents worth of a flowable, high strength bond to save dollars of ramming labor.

Cereals or wood flour may be decreased if a certain amount of southern bentonite is incorporated. In many cases they may be eliminated, as like properties are developed with correct combinations. However, mold skin hardness is decreased when southern bentonite is substituted for any organic binder, and it would be necessary to use a molasses temper water or dextrine water to guarantee a satisfactory skin if molds are allowed to stand for an indefinite period.

Southern bentonite, although not popular in the steel foundry, may have its place once its properties are properly put into use, thus saving money on labor at the machine and the sand reclamation program.

Rebonding—Wet Method

A variation of the popular method of rebonding foundry sands is being studied—adding the bond as a liquid rather than the present dry methods. Less bond is required when added in slurry form.

The power which a bond exerts to hold a mass of sand grains together is largely dependent upon the way it is distributed to the sand. Merely having, for example, 1 lb of bentonite in 20 lb of sand is not sufficient. It must be thoroughly subdivided through every part of the mass.

Powdered bentonite bond seems fine to the average user, and it is ground to be fine. Most of the dry grains are smaller than a 200-mesh sieve, or smaller than 74 microns in diameter (a micron is 1/25,000 of an inch), but each of these 74-micron particles is composed of many thousands of individual flakes of bentonite substance. This myriad of infinitesmal particles, if spread over a surface, have tremendously more coverage than a 74-micron grain. To attempt to reduce a 74-micron grain to a much finer size by mechanical grinding in dry form is impractical.

If bentonite is saturated with water it splits into almost infinite fineness, but when used in the ordinary foundry method the temper water is not sufficient to disperse it.

When this new theory was advanced, there appeared to be two obstacles against using a slurry; (1) that ordi-

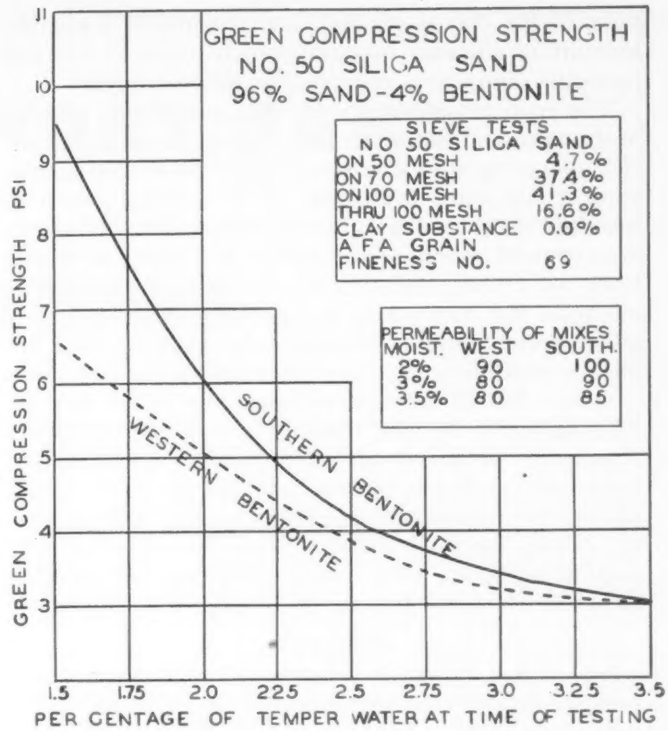

Fig. 4—Effect of adding bond in slurry form on green compressive strength of steel foundry sand.

nary powdered bentonite is difficult to mix with water, and (2) to accomplish the perfect subdivision of bentonite requires more water than is advisable in the molding sand.

A slurry does not work on a new sand facing, as most slurries are made up of 10 per cent by weight of solids, which means that if 4 lb of bentonite are added to the facing sand by a slurry method, in turn 36 lb of water would be used, which would certainly inundate the mixture. However, the slurry method is best employed in used sand and, because used sand contains some live clay, less bentonite additions are required. Since most used or system sands contain fines, the system sands stand a higher proportion of temper water. Most used sand are also rebonded while hot, and therefore some of the added water evaporates.

If the system sand can be sprayed while on a belt as it passes from the shakeout toward the mixer, it is slightly cooled and at the same time the bonding material is being added. It is better to control the bond and temper water at the same time, and certain foundries that have incorporated the process claim that the bond is easier to handle as there is less dust.

It has also been found that slurries have less balling-up tendency and, of course, the bond is better distributed throughout the sand heap as the sand is being lubricated properly with the temper water.

It has been found that maintenance is less because equipment seems to be cleaner, and such mechanical operations as elevator buckets and other sand-handling equipment clog less than where straight dusts are used.

The process bears investigation from the economy standpoint as it is claimed that better than 30 per cent more bonding power can be obtained with a like amount of dry bond. This seems to apply with fire clay the same as with bentonite, but one of the disadvan-

tages of fire clay is the fact that it contains a greater amount of silicious material which tends to cut the pumping equipment required for the operation.

The economy of a slurry or slip-operation is worthy of thought, and indirectly may be the answer to foundries operating with a low-sand-metal ratio that aggravates a hot sand condition. If a cooling system is installed at the muller, it is well known that as the fines are removed much of the cereal and bond is drawn from the circuit, and this is expensive. By ingenious methods, the slurry may be spread on the sand in a satisfactory manner to eliminate the drawing-off of the fines or cool the sands before they return to the muller.

Only a few of the economy measures which may be investigated in the steel foundry have been mentioned. A properly prepared sand will certainly lend itself to better workability at the machine and, of course, better workability encourages more production in the foundry. Money spent on foundry sand control will return itself in less scrap, lower cleaning cost, and is conducive to better all-round foundry practice.

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Continuous Billet Casting Methods Described in Government Pamphlet

GERMAN METHODS FOR CONTINUOUS CASTING of round and sheet billets of nonferrous metals for rolling and extrusion operations are the subject of an Office of Technical Services report, "Metallurgical Practices in Germany—the Fields of Nonferrous Melting and Casting."

The first of two methods, the Junghans process, employs a bottomless, water-cooled mold, with molten metal entering at the top and the ingot emerging from the bottom. A pair of guide rolls below the mold direct the downward path of the ingot. Two holding furnaces are required for each setup. As the first empties, pouring begins from the second and the first refills. A compressor forces the metal into the surge holder, from which it flows into the mold. A nitrogen atmosphere is maintained throughout this part of the equipment.

Fully continuous, excepting the melting stage, the Junghans process is currently used only as a billet casting process, and does not require the high degree of accuracy and close regulation necessary when the process is used in large scale operations.

A similar process, much more simplified but not adaptable to continuous operation, utilizes a hydraulic ram, which forms the bottom of the mold. When pouring begins, the ram moves downward at a rate synchronized with that of the pouring. The Zunkel process, as it is called, employs a mold slightly higher than the solidifying zone of the moving ingot.

The ingot is lowered into a water tank directly beneath the mold. This quench produces a fine grain structure in the metal. A slightly different method used by one plant features a water-spray to produce a milder chilling action for aluminum.

Although the two processes are reportedly limited to semi-finished products in their application to heavy nonferrous metals, the crystal structure resulting from continuous casting is said to be an improvement over structures resulting from the old chilled-ingot mold process. Both processes require only one simple mold for each size ingot; piping is completely absent.

The Scovill Manufacturing Co., Bridgeport, Conn., has used a Junghans machine for almost two years for casting brass ingot. Several cost savings are reported, including a 16 per cent reduction in labor costs under normal conditions. Other advantages reported are the ability to produce ingots of any desired length; lower metal temperatures; absence of gate ends; and fewer chemical analyses required.

Copies of Report PB-81641, "Metallurgical Practices in Germany," are available at $1.25 each from the Office of Technical Services, Department of Commerce.

PREPARING FOUNDRY SAND WITH MANGANESE RESINATE

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SYNTHETIC FOUNDRY SANDS prepared with linseed oil are extensively used, especially for coring purposes, in French foundries. When these sands were first employed, the foundrymen realized the ease with which they collapsed after the metal had been poured, and the possibility of having intricate cores made by less skilled labor than that necessary to manipulate the natural silico-aluminous sand previously used. The general use of synthetic sand with organic binders made it possible to use female help in the French foundries and steel mills.

There was a limiting factor in the use of the molding sand prepared with linseed oil; cores made of siliceous sand mixed with linseed oil possessed excellent cohesion after baking but lacked plasticity and cohesion while green. Hence, metal core driers of proper shapes were necessary to support the cores during handling and baking. The use of driers, which are quite expensive, is justified only for mass production. In making individual cores, or when only a few cores of the same type are produced, certain tricks of the trade are utilized which do not always prove satisfactory. Also, the length of the cores is somewhat limited.

Oil-Bonded Core Sands

Molding sand mixed with linseed oil possesses two important qualities, namely, good behavior in contact with the metal and ease of removal once the metal is cast. When intricate cores had to be made of sand mixed with linseed oil, the cores were divided into several sections to facilitate removal from the core boxes, and the sections were placed on pieces of sheet metal. After baking, the different sections were assembled by means of ties and an adhesive.

Linseed oil bonded core sand had the following composition: white silica sand, type Fontainebleau, 100 parts; raw linseed oil, 3 per cent by weight. The silica (SiO_2) content of the Fontainebleau type sand is approximately 99 per cent, and its fineness 85 A.F.A.

Because of the numerous advantages of core sand bonded with linseed oil, researches were conducted to provide better cohesion in the green cores and thereby eliminate the use of core driers, and also improve the handling and finishing of green cores.

Many natural and industrial products were tested to provide added cohesion to the green cores; molasses, bisulphite, dextrine, resin, etc. Almost all of the French foundries used various mixtures of the so-called "oil mixed" sands in which they incorporated one of products mentioned and obtained excellent cohesion for the usual type of green cores made in large quantities; women with limited training were employed to manufacture cores made in small quantities.

The usual composition of the molding sand used was: white silica sand, Fontainebleau type, 100 parts; molasses or bisulfite, 2-3 per cent by weight; linseed oil, 1 per cent by weight. Quantitative and qualitative improvements were achieved in the foundry when using molding sand mixed with linseed oil, and a cohesion improving agent. But these sands still had an objectionable characteristic when employed for making cores of moderate complexity and medium height. They had a tendency to deform and sink under their own weight. This disadvantage limited their use as a general purpose core sand.

Sand mixed with linseed oil is especially useful in producing large cores where precision of dimensions and shape is of prime importance, as well as the rapid collapse of the core after the mold has been poured. Research was conducted to find means to strengthen the green cores and thereby minimize the possibility of crumbling or deformation under their own weight.

These investigations indicated the use of the well-known property of linseed oils to harden while in contact with the air, resulting in its use in many kinds of paint and varnish. Since the hardening of linseed oil is the result of oxidation by the oxygen of the air, the first tests were conducted with oils made "siccative" by baking them in presence of various elements, namely, metallic elements which possess the property of facilitating the displacement of the oxygen from the air into the oxidized substance.

Different sand compositions mixed with "siccative" linseed oil were baked in the presence of manganese dioxide (MnO_2). The following mixtures were used: white siliceous sand, Fontainebleau type, 100 parts; "siccative" linseed oil—density at 15 C, 0.950; $Mn\ O_2$ content, 0.100.

The "siccativity" (property promoting the drying effect) was determined in the following manner: a coating of oil spread on a piece of glass must be dried and resistant to rubbing with the fingers after having been baked for 45 min.

Large cores made up with siccative linseed oil of the previously mentioned composition showed a rapid

superficial hardening, especially at the regions which were exposed to the air, but this hardening progressed into the mass of the core very slowly and thus immobilized the coreboxes for a period of time that was incompatible with the efficient production of cores. An investigation was made for the purpose of finding means to promote more rapid and deep hardening of the cores. During the tests, experiments were made with various siccative elements in paints, and the following substances were selected as most active siccatives: manganese resinate; lead resinate; and manganese dioxide (MnO_2).

Smelted Resinates

Commercial resinates used in paints are obtained by dissolving the metallic oxides in a fused natural resin (resin of coniferous trees; pine, fir, spruce, or larch). These resinates are called "smelted resinates." These products have the following general composition: smelted manganese resinate—resinous constituents combined with MnO_2 = 45-55 per cent, corresponding to 5-6 per cent manganese; smelted lead arsenate—resinous constituents combined with PbO_2 = 80 per cent, corresponding to 20-25 per cent of lead.

There are also mixed manganese and lead resinates which have the following composition: resinous constituents combined with $PbO_2 + MnO_2 = 67$ per cent, corresponding to approximately 1.5 per cent of manganese and 9-10 per cent of lead.

Commercial manganese dioxide is essentially a natural mineral manganese dioxide containing approximately 90 per cent of MnO_2. The resinate and the manganese dioxide (MnO_2) are reduced to fine powder (minimum fineness – 200) before being incorporated into the sand.

Siccative linseed oil sand was prepared in a paddle type of mixer or tumbling barrel crusher. The different constituents are introduced in the following order: 1. dry sand; 2. powdered siccative substance; 3. linseed oil.

Tests were conducted with a sand of the following composition: Siliceous sand, type Fontainebleau, 100 parts; powdered manganese resinate, 10 per cent of the weight of the sand; baked siccative linseed oil, 3 per cent of the weight of the sand.

Large cores, some weighing as much as 200 kg (440 lb) were made of the foregoing sand composition, the hardening of the sand proved to be sufficient to warrant the removal of the cores from the boxes after periods varying from 6 to 24 hr.

When the cores were exposed to the air in the shop, they hardened thoroughly and became real monoliths. This last property was much appreciated by the workmen, enabling them to remold the cores before baking when it was necessary to check the various thicknesses, dimensions and shapes specified on the blueprints.

Humidity Influences Core Hardening

Later, it was found that the relative humidity of the atmosphere had a definite influence on the period of time required for the cores to harden. The cores will harden rapidly in summer when the air is dry and warm, and will require more time to harden in winter when the air is cold and damp.

Means of completely eliminating the effect of the relative humidity in the air were not found, but this effect was somewhat lessened by:

A. A thorough mixing of the siccative additions.

B. Recessing and hollowing the cores, thereby decreasing the mass that had to be oxidized.

C. Increasing areas of contact with surrounding air.

D. Preparing the cores in heated rooms or near drying and baking ovens.

The fact that it was necessary to wait 6 to 24 hr for the cores to harden may seem at a first glance to be a handicap in the production of cores, but in reality the manufacturing of medium size and large size molds always provides sufficient time for the preparation of cores. A good organization will be able to synchronize the production of cores with the production of molds.

In addition to the advantages mentioned, the use of drying core oil mixed with a resinate enabled the foundry to utilize less skilled labor when making large cores, and working conditions were much improved. The siccative sands mixed with a resinate are quite fluid during 4-5 hr after they are prepared. It can be seen that the great fluidity of these sands simplifies the packing of the sand in the core boxes.

This packing process consists of pouring the prepared sand into the core boxes, and because of the good cohesive characteristics of the sand when it is dry, the reinforcement of cores is reduced to a minimum. In order to hasten the oxidation and also to save sand, many cores are made hollow. The packing of the siccative sand mixed with a resinate may be compared with the ease of operating a core blower, the rapidity of performance being disregarded.

Planning Production Schedule

To the author's knowledge, French foundries have not used a "core blower" to pack the siccative sand mixed with a resinate. Because of the flowability of this type of sand, the author sees no reason why it can not be used in a core blower. In order to make efficient use of sands mixed with a resinate, it is necessary to plan the production of cores in such a way as to take full advantage of the unproductive periods. While the cores are being baked, the workman or the group of workmen may be working on the core boxes.

The schedule of operation is usually along the following lines. In the afternoon, a workman or a crew of workmen will lay on the floor all the core boxes, tie rods, runner pins, riser pins and other necessary tools. All the boxes are filled with the siccative sand mixed with a resinate that was prepared in sufficient quantity several hours previously.

During the filling operation, the workmen placed the necessary tie rods, mountings, packing rings, and packing plugs which will be later replaced by cinder or previously used sand. After this is done the opening through which the sand was introduced is levelled with a strike-off-bar. The packing process is thus finished without the help of a machine or rammer. The filled boxes are left in the foundry overnight, thus allowing the necessary oxidation of the oil and hardening of the cores. In the morning, the cores are removed from the boxes, and after the necessary finishing operations are taken to the core oven for baking.

In large foundries it is possible to organize special crews to do a particular job; filling core boxes, repairing and finishing cores after they are taken from the boxes and, finally, baking the cores. In a well-equipped foundry it is possible to remove cores from boxes which were filled in the morning, and refill them once more

for cores which will be baked the following morning.

Siccative sands mixed with manganese resinate or lead resinate can be used for steel thicknesses up to 30 mm; for wall thicknesses beyond 30 mm a mixture of the manganese resinate with a certain amount of manganese dioxide (MnO_2) is recommended. Particularly recommended is the use of a mixture of the two resinates at sections which are exposed to the mechanical action of the molten metal, e.g., around the gates.

It is possible to use any size of sand particles; finer sand can be used with the resinates because the fusion of the resins during baking increases the porosity of the cores. The baking period varies with the type of oven used; in general, a 4 to 5 hr baking period is required to bake medium-sized cores, allowing 2 hr to reach a temperature of 220 C. It is desirable to reduce the time required for the baking oven to reach this temperature.

Siccative sands mixed with a resinate can be used for molding purposes as well as for the production of cores. Difficult castings, presenting all sorts of intricacies and requiring good finish and accurate dimensions and forms, can be molded with siccative sands.

Special Equipment Unnecessary

Problems connected with the shrinkage and the dressing of certain complicated cast parts, are easily solved when siccative sands are used for molding. The foundry accessories used with silico-aluminous sands can also be used for molding with siccative sands. The same molding practices apply to both the silico-aluminous sand and siccative sand mixed with a resinate. The same patterns can be used in both cases.

As previously mentioned, unskilled workers can properly handle the molding operations when using the siccative sand mixed with a resinate.

Molding technique is quite similar to that of core production. The patterns are placed on a layer of sand or plane plates. Then the workman places the flasks and arranges the accessories (plugs, hooks, bracings, and the like) in the usual manner. The pattern is then covered with a layer of siccative sand, over which cinders or previously used sand is placed. This facilitates hardening of the core and allows it to collapse readily as a result of the contraction of the poured metal. The use of cinders or the previously used sand save an appreciable amount of freshly prepared siccative sand. The filling of the flasks can be accomplished in two ways: (a) placing on the molding boxes a special grating which supports the cinders or the previously used sand; (b) packing in the usual manner a layer of silico-aluminous sand on the cinders.

The molding boxes are then turned over, the joints are finished and the molds allowed to stand for oxidation and consequent hardening. As for the production of cores, this method presents many advantages, both qualitative and quantitative. Many combinations can be efficiently used for increasing the production of molds, especially when the patterns may be place on match plates.

It was also possible to increase the production of large cores by adapting a second corebox, made of siccative sand and molded by means of a core also of siccative sand and made from a wooden pattern.

Certain paints usually used on coreboxes and patterns may be subject to the chemical action of the siccative sands mixed with a resinate, and hence they may stick to the sand particles in contact with the core boxes or the patterns. To avoid this, it is recommended that the core boxes and patterns be coated with a thin layer of alumina white.

Finishing of molds and cores is accomplished by means of glass paper and a file. In this connection it may be pointed out that cores and molds made of siccative sand mixed with a resinate require less finishing than those made with the usual silico-aluminous sand. Any necessary additions to the cores or molds can also be easily made. The molds and cores may be coated after baking, thus greatly improving the finish.

The higher cost of siccative sands is largely offset by the following factors:

1. Lower consumption of siccative sand than ordinary sand.
2. Less skilled help required.
3. Ease of building molds and cores in the foundry.
4. Less finishing of cores and molds required.
5. Better castings from the standpoint of accuracy of dimensions and shapes.
6. Decrease of scrap.

Siccative sands mixed with a resinate were used for the fabrication of complicated cast parts for the French Army and Navy, and they constitute a definite achievement in the modern foundry technique.

Much room remains for research on these siccative sands, especially for use in molding large parts. It is desirable to decrease the hardening time by using siccative agents that will oxidate more readily and thereby eliminate the baking process.

Elect Aluminum Association Heads At 13th Annual Meeting in New York

R. G. Farrell of the Fairmont Aluminum Co. and A. V. Davis of the Aluminum Company of America were reelected president and chairman of the board, respectively, of the Aluminum Association, at the 13th annual meeting, in New York, January 20-22.

Reelected as vice-presidents were H. B. Harvey, Harvey Metal Corp.; H. J. Hater, Aluminum Industries, Inc.; and R. S. Reynolds, Jr., Reynolds Metals Co. D. M. White was reappointed secretary-treasurer.

Directors-at-large elected to serve from one to three year periods included G. A. Ginsberg, United Smelting & Aluminum Co., Inc.; I. P. McCauley, Reynolds Metals Co.; H. L. Smith, Jr., Aluminum Company of America; A. P. Cochran, Cochran Foil Co., Inc.; D. A. Rhoades, Permanente Metals Corp.; R. J. Roshirt, Bohn Aluminum & Brass Corp.; F. B. Cuff, Aluminum Company of America; W. G. Reynolds, Reynolds Metals Co.; and W. A. Singer, Apex Smelting Co.

Other officers elected and appointed included: G. N. Wright, John Harsch Bronze & Foundry Co., reelected chairman of the foundry division and appointed to the board of directors; E. G. Fahlman, elected vice-chairman, foundry division; L. M. Brile, Fairmont Aluminum Co., reelected chairman, sheet division; and G. M. Carter, Sheet Aluminum Corp., appointed to represent the sheet division on the board. H. C. Wilson, Revere Copper & Brass, Inc., was reelected chairman of the extrusion division and appointed to the board of directors.

BRAZILIAN FOUNDRY PRODUCES CHILLED CAR WHEELS

M. M. Siqueira
Chief Engineer
Technical Society of General Founders, Inc.
Sao Paulo, Brazil

AT THE START of the world war, in 1939, Brazilian railroad equipment, principally its rolling stock, had attained a precarious state. Export restrictions which were enforced by nations at war, particularly applying to transportation equipment, caused the situation to become worse from day to day.

In railroad operation, the rolling stock is the equipment most subject to wear and damage. Wheels and brake shoes are the items most involved, these requiring considerable maintenance and replacements.

Brake shoes usually are produced by the railroads themselves, often without proper regard to necessary technical control. The manufacture of wheels, however requires specialized technical knowledge and efficient plant equipment in order to meet existing specifications. Consequently, since local production of car wheels was practically nonexistent in Brazil by 1941, there were numerous railroad cars out of service on most of the Brazilian railroads.

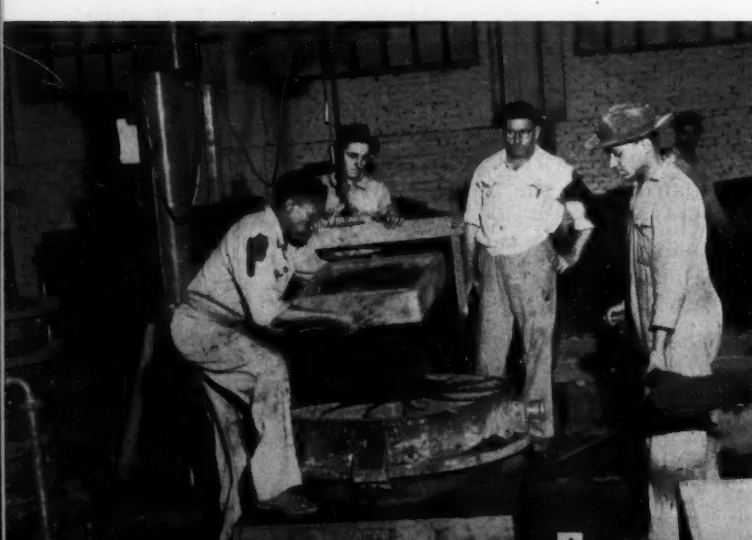
It was at this time that a group of industrialists of the State of São Paulo, Brazil, undertook to form an organization for the purpose of supplying Brazilian railroads with chilled car wheels, vacuum type brake cylinders and brake shoes. The society was organized at the end of 1941, and in April of 1942 the first wooden structure was started for the wheel foundry.

The first car wheel was delivered at the beginning of June. Total area of the buildings then occupied by the organization was 600 square meters. Production of vacuum brake cylinders was started in September, 1944, and of brake shoes in June, 1945. At present, the foundry buildings have a total area of 6,000 square meters.

All handling and preparation of molding and core sand is done in one department. All sand used in the foundry is synthetic sand. Base sands are of two kinds, namely, types "F" and "G," both beach sands. These sands are delivered by railroad over a distance of 250 kilometers. Both sands are of subangular grain type and differ only in grain size and grain distribution. Type "F" sand is used for light castings, and heavy castings are molded in grade "G" sand. New sand is dried in a vertical drier fired by coke. This drier delivers 10 to 12 tons of sand per day, with moisture content of 1.0-1.5 per cent.

Screen No.	Retained, per cent Sand "F"	Sand "G"
30	—	0.4
40	—	3.0
50	0.2	21.4
70	15.0	46.3
100	69.3	24.7
140	14.1	2.9
200	1.0	0.7
270	0.2	0.2
Pan	0.2	0.4
Clay Substance, per cent	1.0	1.0
A.F.A. Fineness No.	72.6	55.5
Base Permeability	180	350

Molding sand is prepared in a unit drive mixer installation which includes vibrating screen and magnetic separator, bucket loader, aerator for prepared sand, and exhauster with dust collector for removal of fines. All motors and the motor generator set are controlled from a central panel. At present, both the used and the prepared foundry sands are manually handled.



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Sand control is practiced regularly at the laboratory, which is equipped for the following tests: fineness, clay content, green and dry strengths, deformation, permeability, hardness and flowability. An 18-in. laboratory type mixer is used for preparing experimental batches.

The sand preparation plant supplies four types of sands— *a, b, c* and *d*. The first two sands are for wheels, and the latter two for miscellaneous castings. These sands contain sea coal, clay, western bentonite and dextrine.

PROPERTIES OF FOUR SAND MIXTURES

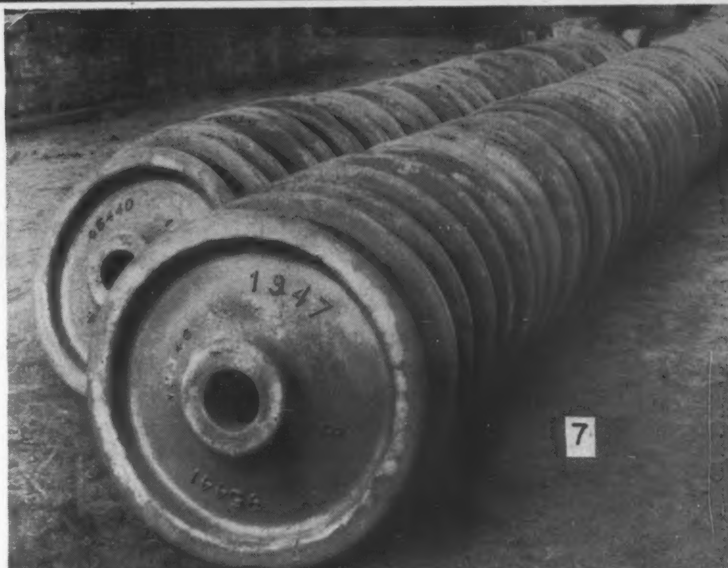
	a	*b*	*c*	*d*
Daily production, tons	1.5	22	18	22
Moisture, percent	6.0	6.7	7.8	4.5
Green permeability	95	115	60	75
Green compression strength, psi	7.0	8.0	8.3	7.0
Deformation, in./in.	.022	.020	.022	.022
Flowability, per cent	62	62	63	70
Hardness	80	80	80	76
Dry permeability	125	145	80	95
Dry compression, psi	60	90	80	70

Sand reclamation is practically complete since only 1.8 to 2.0 per cent of new sand is added for wheels. The sand department employs nine men and delivers an average of 7 metric tons of prepared sand per hour.

Cores are prepared with all new sand containing clay, corn oil, dextrine and water. Green strength averages 2.0 to 2.5 psi. An electrically heated core oven of 45-kw capacity is used for drying cores on a 3-hr cycle at 200 C. A crew of 19 men is employed for the average production of 500 cores per day.

Electric power is furnished at a primary voltage of 3,800 volts. The plant substation is equipped with a primary oil switch with overload and low-voltage relays. The secondary substations supply light and power to the plant and to the electric furnace. These include

Fig. 1—Single jolt type machine is used for drag molding. Fig. 2—Cope molding machine is of single jolt type. Left—drag on the car is ready to receive the cope and chiller. Fig. 3—Wheel pouring station, showing the wheel mold just before pouring. One cupola is in operation and the other is being repaired. Fig. 4—Another view of the pouring station showing the cupola control, the test block collection on the shelves, and the bottom-pouring ladle. Fig. 5—A 28-in. type "B" car wheel at the shakeout. Fig. 6—Annealing pits, 16 in all, with a capacity of 25 wheels each. Fig. 7—One day's production of car wheels ready for inspection by the engineer.



six transformers, of which two supply power for the plant, one for light, and three for the electric furnace.

Total connected power is 300 kw (410 hp), excluding the electric furnace. Total power consumed is 140,000 kwh per month, average.

Metal

Molten metal is supplied by two 32-in. cupolas which operate on alternate days. Also, a three-phase electric furnace of one-ton capacity, equipped with a 270-kw transformer is used. Two 42-in. cupolas will soon be substituted for the old cupolas.

All pig iron used is produced in Brazil, in charcoal blast furnaces located in Minas Gerais and São Paulo. Both South African and Brazilian cokes are used. Since these have a rather high ash content (16 per cent and 24 to 26 per cent, respectively) a coke-metal ratio of 1:10 is used, with a consequent tapping temperature of 2700 F. Fluxing material used is limestone containing 2.5 per cent of SiO_2 occasionally mixed with CaF_2.

Average Size of Coke Used

Mesh, in.	per cent
1	10
2	20
3	30
4	20
5	10
6	10

First metal is poured at 7:30 am and cupolas are dumped at 5 pm. Cupolas are tapped continuously and slagged by a front slagging spout. Iron is tapped into a 4-ton U-shaped desulphurizing ladle, from which it is distributed to bottom-type pouring ladles. Three types of charges are made daily, and these are of the following compositions:

Component	Wheels	Brake Shoes	Miscellaneous
Si, per cent	0.60	1.10	2.80
Mn, per cent	0.75	0.70	0.60
S, per cent	0.14 max.	0.17 max.	0.17 max.
P, per cent	0.30 max.	0.30 max.	0.30 max.
Total Carbon, per cent	3.40 min.	3.10 max.	3.10

Cupolas are charged mechanically by means of a bottom-discharge bucket. Composition of metal is adjusted by means of ferro-alloy briquets, added with the charge, or granulated ferro-silicon, ferro-chromium or telurium briquets added at the spout.

Air for both cupolas is supplied by a 24-in. centrifugal blower equipped with a 25 hp, 3,400 rpm motor. Air control is by means of an airweight controller. The melting department employs 21 men.

A horizontal single stage type, water cooled compressor supplies 450 cfm of air at 100 psi pressure. This compressor is equipped with an aftercooler.

Production Program

Since 1942, wheels have been produced in ten different types, 24, 28, 33 and 36 in. in diameter for cars weighing 30, 45, 60 and 75 metric tons. While types have remained unchanged, design and weight of wheels have been improved, resulting in a marked improvement in quality. Wheels are produced to the specifications shown in the table.

Wheels are machine molded by means of plain jolt machines for copes and drags. Handling of molds is done by four jib cranes, equipped with 1-ton capacity electric hoists. Pattern plates are built in cast iron with bronze insets for marking the letters and numbers.

Car Wheel Specifications

Size, in.	Type	Weight, kg	Car Weights, metric tons
24	TA	175	30
	TB	185	45
28	A	211	30
	B	226	45
	C	255	60
33	NB	320	45
	NC	355	60
36	LB	370	45
	LC	420	60
	LD	460	75

Cores are set and flasks closed on cars which transport molds to the pouring station and to the shakeout. Molds are poured by bottom-tap ladles at the rate of 12 wheels, of 250 kg each, per hour. Pouring speed averages 35 to 40 kg of metal poured per second at a temperature of 2400 F (1320 C).

Cooling time varies according to pouring temperature, size of wheel, and pitting speed. After this period, which is accurately maintained, wheels are shaken out and transferred to annealing pits of the vertical type, with a load capacity of 25 wheels each. After a 72-hr. anneal, wheels are removed for cleaning, weighing and measuring. The cooling rate of wheels in pits is maintained at a rate of 6 C per hour during the first 24 hr in order to eliminate internal stresses completely. Daily thermal tests and impact tests are taken in order to control these stresses.

Personnel and Capacity

Present average output of the foundry is 75 type "B" wheels per day. This can easily be increased to 125 wheels. Actually, the market is not consuming even 50 wheels per day. At the present rate, 32 men are employed in car wheel production.

Miscellaneous castings, such as electric motor frames and covers, parts for automatic scales, brake shoes, sewer castings, etc., are molded on four jolt squeeze molding machines (three machines are of Brazilian manufacture), one jolt squeeze rollover stripper machine for drag work and used in connection with a jolt stripper machine, and a jolt squeeze stripper machine. The larger machines are serviced by jib cranes equipped with electric hoists. This department employs 40 men.

Production of vacuum brake cylinders started in September, 1944. Cylinders of 18, 21 and 24-in. diameter, which produce a direct braking load of 1100 to 2100 kg at 70 per cent vacuum, are manufactured. Parts for this equipment are machined in a separate shop equipped with two vertical lathes, five horizontal lathes, three boring machines, and one radial type boring machine. Cylinders are submitted to individual tests for leakage and efficiency. Maximum output is 400 cylinders per month, with 30 men employed.

The technical staff includes five engineers, and a total of 180 men are employed at the plant. Maximum capacity of the plant reaches 1200 tons per month when casting the heaviest car wheels.

OHIO REGIONAL FOUNDRY CONFERENCE

Six Chapters and Case Institute Hold First Regional Meet

THE FIRST OHIO REGIONAL FOUNDRY CONFERENCE was a success and well attended despite a surprise snowstorm of blizzard proportions.

Held March 11 and 12 at Case Institute of Technology, Cleveland, the conference was sponsored by the A.F.A. Northeastern Ohio Chapter and Case Institute, in cooperation with the Canton, Central Ohio, Cincinnati, Toledo and Northwestern Pennsylvania Chapters. In addition to luncheon and dinner meetings, and a top management meeting, the conference consisted of three sets of simultaneous technical sessions devoted to gray iron, malleable iron, steel, nonferrous metals, and patternmaking, and a joint session on education.

The conference was opened in the physics building at Case Institute of Technology by Howard C. Gollmar, Elyria Foundry Div., Industrial Brownhoist Corp., Elyria, Ohio, chairman of the Northeastern Ohio Chapter. Following introductory remarks, Prof. K. H. Donaldson of Case, A.F.A. National President Max Kuniansky, and National Secretary-Treasurer Wm. W. Maloney spoke.

Prof. Donaldson welcomed the conference attendants to Case, and credited Prof. Gerald M. Cover with any success the conference might enjoy from the standpoint of Case participation. Mr. Kuniansky and Mr. Maloney commented on the reputation the Northeastern Ohio Chapter has for doing well anything that it starts, and called for Cleveland-area plants to send as many men as possible to the conference.

A paper by Frank G. Steinebach was read by William G. Gude; both are with Penton Publishing Co., Cleveland. The paper stressed the shortage of metals and coke and pointed out that there seems to be little possibility of early relief.

Following the opening session, conference attendants went to the general luncheon at the Tudor Arms Hotel, or to the top management luncheon. Dr. Harvey H. Davis, vice-president, Ohio State University, Columbus, discussed the "ABC's of Taxation" at the general luncheon.

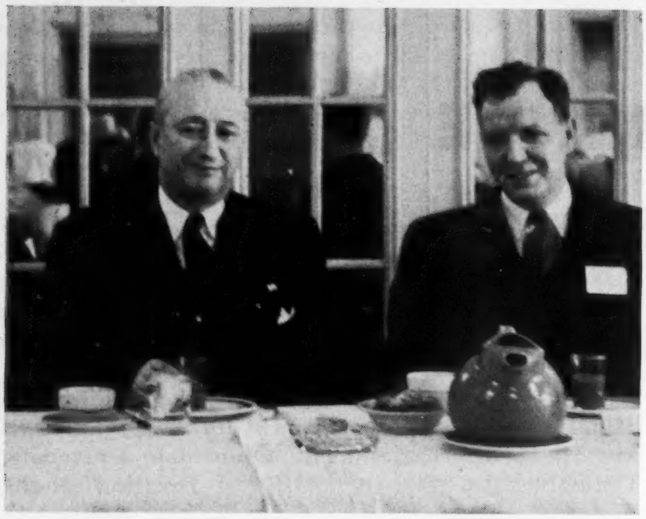
Forty-five members of top management of Cleveland-area foundries gathered at the Wade Park Manor for luncheon to hear National President Max Kuniansky express the importance of keeping up-to-date with the developments constantly being made toward improving foundry practices. Chapter Chairman Howard C. Gollmar, presided.

President Kuniansky traced concisely the tremendously increased interest in foundry technology and practical improvements made in the past 15 years.

"During this period of time," he said, "foundries have paid greater attention to applications of metallurgical and technological advances than in the previous fifty years. Today, the foundry unwilling to keep up with these advancements will find its business restricted to operations characteristic of an industry once ruled by guesswork instead of, as today, by precise and consistent control."

National Secretary-Treasurer Wm. W. Maloney, brought out some of the major activities of A.F.A. which result from the demands of a steadily increasing membership. Specifically, he mentioned the growth in chapters, the enthusiastic interest of the over 10,000 A.F.A. members, the research projects of the Association, its concentration on technical activity, and par-

Officials of the Northeastern Ohio Chapter and other chapters cooperating in the first Ohio Regional Conference at the registration desk in the physics building of Case Institute of Technology.



Dr. Harvey H. Davis (left), vice-president, Ohio State University, and Conference Chairman Elmer C. Zirzow, National Malleable & Steel Castings Co.

ticularly its vastly increased prestige as a technical society. The point was emphasized that foundry employes will assume an interest in broadening their knowledge of foundry practice only if management shows an interest in such activities.

Walton L. Woody, National Malleable & Steel Castings Co., Cleveland, past National Director of A.F.A., spoke briefly on the interest his company takes in having employees participating in Association work.

"No plant," he stated, "can be any better than the sum of the technical and practical information possessed by its personnel."

He expressed the hope that foundrymen in the Cleveland area would continue to support strongly the local A.F.A. chapter by taking an interest in the chapter's numerous activities.

Among those introduced at the speakers' table were the following representatives of other Ohio chapters participating in the Conference: John W. Clarke, assistant foundry superintendent, General Electric Co., Erie, Pa., Chairman, Northwestern Pennsylvania Chapter; F. W. Fuller, field engineer, National Engineering Co., Columbus, Ohio, Vice-Chairman, Central Ohio Chapter; A. D. Barczak, vice-president, Bardes Forge & Foundry Co., Cincinnati, Vice-Chairman, Cincinnati District Chapter; and R. B. Bunting, foundry superintendent, Bunting Brass and Bronze Co., Toledo, Ohio, past Chairman of the Toledo Chapter.

Elmer Zirzow, core room foreman, National Malleable & Steel Castings Co., was presented as Chairman of the Conference Committee and was praised for the excellent program and attendance.

G. K. Dreher, executive director, Foundry Educational Foundation, Cleveland, was called on for brief remarks on the progress of the Foundation and its program in developing greater interest between foundries and a group of engineering schools.

Gray iron sessions, featuring talks on cupola operation, casting defects, and use of basic metallurgy in combating current material shortages, were under the chairmanship of J. G. Goldie, general superintendent, M.B.M. Foundry Inc., F. W. Fuller, Henry J. Trenkamp, president, Ohio Foundry Co., and A .B. Barczak.

Basic theory of cupola operation was summarized by Thaddeus Giszczak, research metallurgist, A.F.A. Cupola Research Committee. His talk on present day coke, slag control and oxygen-enriched blast, covered material being presented in a series on cupola operation currently appearing in AMERICAN FOUNDRYMAN.

W. B. McFerrin, metallurgist, Electro Metallurgical Co., Detroit, gave an authoritative illustrated discussion of blows, shrinks, scabs, and buckles. Much of Mr. McFerrin's material was taken from the recent A.F.A. publication, ANALYSIS OF CASTING DEFECTS, a book which he helped write.

Control Helps Overcome Material Shortage Problems

Material shortages and basic gray iron metallurgy were covered in the third gray iron session by R. G. McElwee, manager of the iron foundry division, Vanadium Corp., Detroit. He pointed out that the materials situation is not likely to improve and that foundrymen will have to make the most of what they have.

Better supervision and control can make up for

Foundrymen listen attentively to engineering student paper on effect of boron on malleablization of white iron.

(Large photographs courtesy W. H. White, Jackson Iron & Steel Co.)

shortage of materials in large part, he said, but he cautioned against attempting to make high tonnages of castings when material sufficient only for low tonnages is available.

Carbon control was emphasized because of the trend toward lower carbon, a result of poor or insufficient coke. The lower carbon irons tend to shrink more, Mr. McElwee said in bringing out the value of an analysis close to the eutectic which eliminates a long solidification interval and reduces the tendency to shrink.

Silicon, assuming new importance because of the shortage of carbon-bearing materials, can be used to raise the carbon equivalent of irons. Although silicon plays a dual role as a graphitizer and a ferrite-strengthener, it is dangerous to increase it too high because excessive silicon causes marked hardness increases and reduces carbon pickup. Foundrymen can meet tensile strength requirements with higher carbon equivalent irons which have been inoculated, and have less shrinkage trouble, the speaker said.

Explains A.F.A. Cupola Research Work

As chairman of the A.F.A. Cupola Research Committee, Mr. McElwee explained the operation of the group, especially relative to reports of unusual examples of cupola practice. He gave several examples of cases tracked down by committee members which turned out to be false or greatly exaggerated. The committee checks all new methods reported because it will not sponsor publication of gossip, he said. Slag, which can be a virtue rather than a necessary evil, is under study by the committee.

In answer to a question, Mr. McElwee said that chill depth is not always a direct indication of hardness because of the influence of melting conditions and tramp elements. Nevertheless, the example was cited of an Ohio foundry making over 400 chill tests a day and having no customer complaints because of hard castings. Most complaints on high hardness are due to hard edges rather than a higher hardness in the body of the casting, he explained.

The speaker closed the question-and-answer period with the statement that A.F.A. is cooperating with other technical and engineering societies in studying the engineering properties of gray iron. The material should stand on its own feet; advantage should be taken of gray iron's inherent properties such as wear resistance, lack of notch sensitivity, and damping capacity, instead of trying to borrow the properties of other materials, said Mr. McElwee.

Hot Tears Interest Steel and Malleable Founders

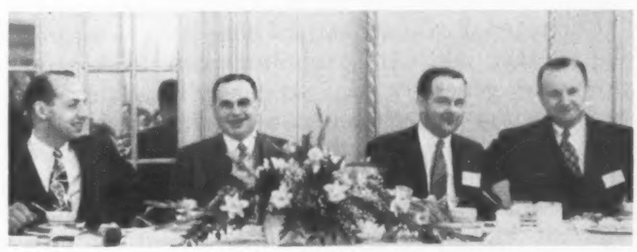
One of the malleable iron sessions and one of the steel sessions covered essentially the same subject: hot tears. C. W. Briggs, technical and research director, Steel Founders' Society, Cleveland, discussed "Hot Tears in Steel Castings," a subject on which he has done much research and on which he has written extensively in periodicals and in books. In covering the basic factors involved in hot tears, and in giving specific recommendations for avoiding them, Mr. Briggs drew on his extensive writings and also presented some of the same ideas reported below for B. C. Yearly, assistant manager, National Malleable & Steel Castings Co., Cicero, Ill., in his talk "Cracks in Ferrous Castings—Their Causes and Remedies."

Steel sessions were under the chairmanship of

Prof. D. C. Williams, Ohio State University, Walter E. Sicha, Aluminum Co. of America, and Thaddeus Giszczak, A.F.A. cupola research metallurgist, (left to right) at one of the conference luncheons.

(Small photos by Sterling Farmer, Sand Products Corp.)

Tom D. West, West Steel Casting Co. (starting left), J. H. Tressler, Hickman, Williams & Co., and James G. Goldie, M.B.M. Foundry Inc.



Left to right, Prof. Eleroy Stromberg, Cleveland College, F. Ray Fleig, Smith Facing & Supply Co., Robert D. Walter, Werner G. Smith Co., and G. K. Dreher, Foundry Educational Foundation.

Thomas D. West, vice-president, West Steel Casting Co., Prof. Gerald M. Cover, I. M. Emery, works manager, Massillon Steel Casting Co., Massillon, Ohio, and Prof. D. C. Williams, Ohio State University, Columbus.

John Clarke, substituting for Earl Strick, finishing superintendent, Erie Malleable Iron Co., Erie, Pa., who was prevented from reaching the conference by an automobile accident, was chairman at the first malleable iron session. J. J. Witenhafer, manager, Columbus Malleable Iron Co., Columbus, Ohio, and Edward Bossart, Maumee Malleable Castings Co., Toledo, Ohio, were the other malleable session chairmen.

Cold cracks occur when the metal is strongest, hot cracks when the metal is weakest, said Mr. Yearly in discussing these casting defects in the first malleable iron session. Hot tears, he explained, occur above the critical temperature while cold cracks form at or near room temperature.

Defects Due to Hindered Contraction

Both defects are caused because castings are prevented from contracting normally in all sections. Two assumptions can be made, according to Mr. Yearly:

1. A casting won't crack until it is solid or until no fluid metal is available to fill the void caused by a crack.
2. Force due to contraction must exceed the ultimate

tensile strength of the section at a time when the ductility is too low to accommodate the force.

Pointing out that steel or white iron castings must be able to contract 0.015 in./in. in cooling 2000 F, or deform, the speaker cited the low strength and high ductility at higher temperatures as shown by the data below. These data for short time physical properties of hard iron (silicon, 1.0, and carbon, 2.40-2.45 per cent), were developed in the research laboratory, National Malleable & Steel Castings Co., Cleveland.

Temperature deg F	Elongation percent	Tensile Strength
1100	0.0	68,000
1200	3.0	45,000
1300	6.0	20,000
1400	8.0	15,000
1500	12.0	9,000
1600	14.0	8,000

Using as an example a 10-in. bar, anchored at both ends, Mr. Yearly pointed out that in cooling 2000 F the bar would attempt to contract 0.15 in. In doing so, the bar can pull away from its anchors, stretch, or break. As long as the bar deforms, its strength will not be exceeded.

Lists Causes of Hot Tears

Commercial castings are not simple bars, of course, the speaker said. He explained that the minimum properties generally occur at a small section near a heavy section. Attempts to cure hot tearing with chills may lead to no results, if the chill is too light, or to cracking at the ends of the chill if it is too heavy. The use of a cooling fin or cracking bead is effective provided it does not increase the total linear contraction or cool so rapidly it creates cracks at the ends of the fin.

The causes of hot tears, given by Mr. Yearly in order of decreasing importance, are:

1. The mold, core, or casting itself, restricts normal contraction of the casting beyond its ability to deform.
2. Anything producing temperature differences and therefore property differences.
3. Pouring temperature variations which materially affect temperature gradients.
4. Analysis variations which change high temperature properties.

In explaining that the sand is expanding while the metal is contracting, the speaker pointed out the difficulty of compromising mold and core hardness, strength, and collapsibility. Weight measurements of cores were cited as a means of controlling sand packing, and an example was given of a 19 lb core which caused cracking while the same core weighing only 17 lb did not cause cracks. The weight of a core generally can be reduced 10 per cent without harm, it was pointed out. This is frequently more effective than adding special materials to the core mixture.

Measure Mold Hardness Three Ways

Stating that molds cannot be weighed conveniently, the speaker suggested three methods for measuring and controlling mold hardness: 1. Use a mold hardness tester; not considered sufficiently sensitive. 2. Count the number of jolts, a method effective only if sand flowability is closely controlled. 3. Feel the mold.

Design features and other factors producing temperature differences can be minimized by correct gating. In general, higher pouring temperatures cause more hot tears. Although some elements cause hot shortness and contaminants may cause a change in high temperature physical properties, it is a mistake to blame the metal for hot tears, according to Mr. Yearly. If a slight variation in analysis causes hot tears the factor of safety in molds and cores should be increased.

Cold cracks or strain cracks occur at low temperatures but are caused by conditions which existed at high temperatures!

EDITOR'S NOTE: The report on the Ohio Regional Conference will be concluded in the May issue of AMERICAN FOUNDRYMAN.

Cleveland Foundrymen Complete Foremanship Training Course

CLEVELAND FOUNDRY FOREMEN AND SUPERVISORS studied "Foremanship and Human Relations" for 15 weeks in a course sponsored jointly by the A.F.A. Northeastern Ohio Chapter and the Cleveland Trade School. Fred A. Dunmire of the Board of Education taught the men two hours a night, one night a week, using the conference method. At the conclusion of the course Mr. Dunmire received a gold pencil from his students. Harold Wheeler, personnel director, Superior Foundry Inc., spoke at the wind-up dinner at the Carter Hotel where the picture was taken.

JOINT EDUCATIONAL PROGRAM FOR STAFFING FOUNDRIES

RECRUITING AND RETAINING WORKERS have been difficult for Erie foundries since the inception of the National Defense Program in 1940. These difficulties have been aggravated in recent months due to industrial expansion. The need for some type of corrective action is imperative.

The Northwestern Pennsylvania Chapter of A.F.A. and the local and district offices of the Pennsylvania State Employment Service, through a joint committee,* have evolved a plan to aid in the staffing of foundries. These organizations feel that the foundry industry is an integral part of the economy of Erie and its adjacent areas and that foundry work offers opportunities for interesting and gainful employment.

The committee first determined the causes for the shortage of foundry workers. Seven interviewers in the Pennsylvania State Employment Service, who service most of the foundries in Erie, were asked for the reasons given by applicants refusing to accept foundry work. Opinions of directors of A.F.A., foundry management, and the employment managers and personnel directors of firms operating foundries were obtained at meetings with these groups.

Data thus obtained revealed that the following reasons are the chief causes for the shortage:

1. Objections by potential, former, and present workers that foundry work is dusty, strenuous, unhealthy, dangerous, socially undesirable and not sufficiently challenging.

2. Availability of other, more attractive jobs in the community.

3. Lack of sufficient information by the public as to the advantages of foundry work.

Suggestions for alleviating the situation were solicited and the best are shown below. No one remedy will resolve the entire foundry problem. However, the continuous application of all the suggestions should improve matters greatly.

The suggestions fall into two categories—internal and external. The terms distinguish between activities for foundrymen and foundries, and activities directed at the public.

Study Working Conditions and Environment

Each foundry should make an intensive study of the following conditions:

1. *Housekeeping*—Aisle space, piling of materials and equipment, etc. should be studied. Corrective measures should improve the morale of present workers and eliminate accident hazards which may exist.

2. *Mechanization*—Consider instances where machines or devices may be installed to eliminate excessive lifting, carrying, or bending.

3. *Dust and smoke control*—Installation of hoods, ventilators or isolation of cleaning rooms should be considered. Reduction of dust and smoke in foundries where they are excessive may raise the social standing of foundry work in the opinions of many workers.

4. *Showers and wash rooms*—Clean, modern facilities are essential in any modern industrial plant.

5. *Safety precautions*—Moving and swinging parts of equipment should be painted an outstanding color. Crane hook-up methods should be checked. Care in handling of molten metal and other precautionary measures should be emphasized. Adequacy of safety clothing and protection should be determined.

Personnel Practices Important

Proper induction, training and supervision are essential to efficiency and morale. Foundries should examine their personnel practices from the following viewpoints:

1. *Formal induction program*—Give adequate information to the new worker about the company's policies, its products, and the relation of his job to the whole. This should increase morale and elevate the job in the eyes of the worker.

2. *On-the-job training*—Attention to the development of workers' abilities will help insure the supply of skilled workers and should also increase morale.

3. *Supervision*—Although it is realized that foremen are often busy with other matters, time should be taken to assure the worker that the employer is interested in his welfare and his problems.

4. *Rest periods and rest rooms*—Rest periods granted on a regularly scheduled basis diminish fatigue and improve morale.

5. *Promotional policies*—Be sure that good workers are not being denied upgrading because they are especially proficient on their present jobs.

6. *Plant visits*—Arrange an "open house" for the public.

7. *Analyze turnover*—Study the department, occupation, length of service, and age of workers voluntarily leaving, and determine the reason for such action.

Carry Out Public Relations Program

A good public relations program is believed to be an important phase of external educational activities

JOINT COMMITTEE FOR STAFFING ERIE FOUNDRIES

REPRESENTING NORTHWESTERN PENNSYLVANIA CHAPTER OF A.F.A.

John W. Clarke, General Electric Co.—*Chapter Chairman*
H. L. Gebhart, United Oil Manufacturing Co.—*Chapter Secretary*
Joseph A. Shuffstall, National-Erie Co.—*Chapter Treasurer*
Earl M. Strick, Erie Malleable Iron Co.—*Chapter Director*
Fred J. Eisert, Urick Foundry Co.—*Chapter Director*
James J. Farina, American Sterilizer Co.—*Chapter Director*
Frank P. Volgstadt, Griswold Manufacturing Co.,—*Chapter Director*
Bailey D. Herrington, Hickman-Willams Co.—*Chapter Director*

REPRESENTING PENNSYLVANIA STATE EMPLOYMENT SERVICE

Carl J. Minzenberger	Henry Stanczak
William J. Smith	Bernard Williams

* Prepared from minutes of meetings of the joint committee by Earl M. Strick, Erie Malleable Iron Co., Director and Past Chairman, Northwestern Pennsylvania Chapter of A.F.A.

so the committee developed the following ideas.

1. Arrange for a series of feature articles in newspapers and for radio releases dealing with the history of foundry work in Erie and the opportunities in the foundry industry. Pictures of foundry operations should add weight to the releases.

2. Talk to Parent-Teacher Association groups on the advantages of foundry work.

Give Foundry Career Counselling

Foundrymen should participate in as many vocational guidance activities as possible.

1. Discuss foundry work with groups of high school students. Use slides or motion pictures to supplement the talk. Arrange for plant visits by high school students and school guidance people.

2. Furnish school guidance people with occupational briefs and inform them of occupational data available through the Pennsylvania State Employment Service.

3. Petition the Erie school district for the inclusion of a foundry course in the school curriculum.

4. Determine and publicize the courses available in night classes that are related to foundry work or supervision.

Assign Responsibility for Program Phases

If the plan for staffing foundries is to be successful, it will be necessary for each interested group or organization to assume the responsibility of carrying out certain parts of the program. Due to the nature of some of the suggestions, the group to which these sections of the operation would be allocated is obvious. However, to insure attention to the entire effort, the suggested assignments for each interested group are listed herewith:

Management—Management can best insure the success of the plan by working towards elimination of the aspects of foundry work which are considered physically and socially undesirable. The management of each foundry, in conjunction with supervisors, personnel men, and its safety and industrial engineers, can review present practices and conditions regarding housekeeping, mechanization, dust and smoke control, showers and wash rooms, and safety precautions. Improvements decided upon might be considered for immediate application, for much of the success of the plan hinges upon this portion of the program.

Management can also lend the weight of its support to training programs such as induction training, on-the-job training, safety training, and supervisory training. Representatives of management should discuss the inauguration of a foundry course in the high school curriculum with Erie school district officials.

Attention to promotion policies and the establishment of regularly scheduled rest periods and rest rooms is also the task of management.

Recommend Foundry Visitations

The holding of "open house" or inspection tours for the public and arrangement of plant tours for high school students and school guidance people can also be carried out by management as a means of informing these people on the nature and operations of a modern foundry.

Personnel departments of plants should analyze separations to isolate intraplant problems.

Northwestern Pennsylvania Chapter of A.F.A.—The local chapter of the American Foundrymen's Association, a technical society, may best contribute to the success of the plan by utilizing the experience and specialized knowledge of its members.

The A.F.A. can furnish to local newspapers and the radio stations details on the colorful history of foundry work in Erie, the interesting aspects of foundry work, and the career opportunities.

Its members can appear before Parent-Teacher Associations, student groups, and civic and medical groups, and discuss foundry work with them.

The chapter can sponsor foundry exhibits, old timers meetings, and can invite to its technical meetings school, civic, city, and county officials when there is something at these meetings that will be of interest to them.

Sponsor Special Group Meetings

This organization of foundrymen, by active interest in various youth organizations such as the Boy Scouts, Boys Clubs, Catholic and Jewish Boys Welfare Associations, and YMCA can materially help the foundry industry and the boys as well.

Pennsylvania State Employment Service—The State Employment Service is a public agency interested in offering its services and in marshalling all area resources toward the solution of personnel problems.

The PSES can determine the courses available to foundry employees through the local school district in instruction related to foundry work.

It can make available to the foundry industry personnel and training techniques and data now in its possession and which it may obtain in the future from its national, state, district and local offices.

Distribute Occupational Briefs

Occupational briefs on foundry occupations in Erie can be prepared and distributed to school guidance people, personnel men, and others interested in vocational guidance and counseling.

School guidance people can be told of occupational data available through the USES.

To do everything possible in seeing that this program is carried out, the joint committee of the Northwestern Pennsylvania Chapter of the American Foundrymen's Association and the Pennsylvania State Employment Service will meet regularly to discuss the problem of recruiting and retaining foundry workers, to encourage continuous attention to the situation, and to develop new foundry educational programs.

Announce College Foundry Course

The University of California will continue its foundry course under the direction of Joseph A. Burgard of the Columbia Steel Co., it was recently announced through the University Extension Service.

The course, "Fundamentals of Foundry Practice and Operation," is scheduled to cover all phases of foundry production and will include the following subjects: molding, molding equipment, gating and heading practices, types of molds, core room practice, cleaning and finishing castings, molding and coremaking machines, melting units, refractories in the foundry, heat treating of castings, and chemistry of steel castings.

The class meets Thursday evenings, 7-9:30 p.m., at the downtown University Extension center, 813 South Hill St., Los Angeles.

Richard Jordan Dies

RICHARD F. JORDAN, 62, vice-president in charge of sales for Sterling Wheelbarrow Co., Milwaukee, Wis., died April 5 at his home after a prolonged illness. Mr. Jordan had been treasurer of the Wisconsin Chapter of the American Foundrymen's Association since its inception in 1935 and had long been treasurer of the annual Wisconsin Regional Conference.


Richard F. Jordan

Born in Boone, Ia., February 28, 1886, he attended grade and high schools there prior to receiving a degree in mechanical engineering from Iowa State University in 1908. After graduation, Mr. Jordan joined Hill, Clark & Co., Chicago, as a salesman. In 1912 he established an internal combustion engine sales organization in Chicago. Mr. Jordan joined the Sterling Wheelbarrow Co., as assistant sales manager in 1918 and was appointed sales manager of the organization in 1931.

Installed in Foundry Laboratory, MIT Is Fourth A.F.A. Student Group

MEMBERS OF THE A.F.A. STUDENT CHAPTER at Massachusetts Institute of Technology, Cambridge, gathered in the school's foundry laboratory on March 2 to participate in the installation of the student group. Gerald Grott, chairman of the student chapter, presided. Over 40 students, foundrymen, and faculty representatives attended, in spite of a blizzard.

National President Max Kuniansky made the principal address, and urged the chapter members to make the most of their opportunities to increase their knowledge of foundry practice. He cited numerous instances of engineering college graduates being employed by his and other foundry companies, and stressed the need for better technology and engineering proficiency in metal casting plants.

Chairman Grott introducd H. F. Taylor, associate professor at MIT, and a 1946 Gold Medalist of A.F.A., as the faculty advisor to the group. Industrial advisor R. F. Harrington, Hunt-Spiller Mfg. Corp., Boston, also a Gold Medalist, expressed the willingness of New England foundrymen to cooperate with the MIT student chapter.

Representing the New England Foundrymen's Association was Chairman M. E. Hosmer, Hunt-Spiller Mfg. Corp., who pledged the support of the New England organization to the new A.F.A. chapter. Also representing local foundrymen was Walter M. Clark, D. W. Clark & Co., Boston. An informal dinner in the foundry laboratory preceded an examination of laboratory facilities. Expected to be second to none in the country when in full operation they will include an electric and a cupola melting furnace, shake out, sand handling system, and other auxiliary equipment.

National Secretary-Treasurer Wm. W. Maloney presented the traditional cast iron rattle to the chapter chairman and described several interesting phases of A.F.A. work. He emphasized the importance of keeping in contact with foundry operations through plant visitations and interviews, and contributed a set of Association literature for the foundry library. In his message of installation he stated that foundrymen are increasingly aware of the importance of graduate engineers to casting operations and expressed confidence that the chapter's officers and advisors would maintain continuous interest in foundry practice.

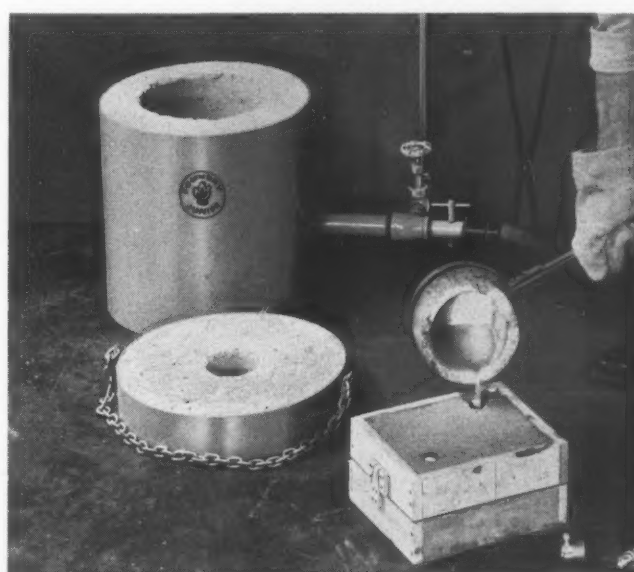
Regular monthly meetings to be addressed by prominent foundrymen are planned by the chapter.

The MIT student chapter is the fourth to be approved by the National Directors of A.F.A. Others are at the University of Minnesota, Ohio State University, and Missouri School of Mines. A student group recently formed at Oregon State College has petitioned for recognition; faculty advisor is Prof. H. R. Dahlberg, a former chairman of the Minnesota student chapter.

Portable Foundry Unit Now Available For Student and Home Craftsman Use

DESIGNED AND BUILT FOR HOME CRAFTSMEN, vocational schools, junior colleges, laboratory, and commercial use, a small melting furnace complete with all equipment and tools necessary to produce sand and plaster mold non-ferrous castings, is now available.

The melting unit consists of furnace, crucibles, tongs, crucible holder, skimming and stirring rods, asbestos gloves and goggles. The molding equipment consists of a special grade foundry sand, flask, riddle, rammer, and other tools. Manufactured, natural, or bottle gases may be used as fuel at normal kitchen pressures. Air may be supplied by a vacuum cleaner or motor driven blower and the gas-air mixture is controlled by easily adjustable valves. Gas consumption is approximately



2 cfm. The furnace will hold crucibles having a working capacity of 10 lb of aluminum or 34 lb of brass or bronze, amounts suitable for small experimental heats and Boy Scout handicraft classes.

Sawyer Bailey Corp., manufacturers of the equipment, also has available a wide variety of casting alloys and supplies adaptable to model building and casting.

WHO'S WHO

F. J. Fere

F. J. Fere, author of *Molding Sand Prepared With Manganese Resinate,* page 147, has written a guide-book on casting design and several technical papers . . . A graduate of Laon College, Aisne, France, he has served in supervisory and executive engineering capacities in several of France's largest steel works and foundries, including the Renault plant at Billancourt, the Anjou Steelworks, the Vosges Foundries, the Gennevilliers Steelworks of Paris, and was technical director of the Electro-metallurgical Association of St. Beron from 1926 to 1929.

J. G. Mezoff

John G. Mezoff, formerly research metallurgist at Dow Chemical Co.'s Midland, Mich., plant, is co-author of *Gating System Designs Affect Pouring Rates,* page 107 . . . This is the fourth A.F.A. paper written with H. E. Elliot . . . Production manager, Saginaw Bay Industries, Inc., Bay City, Mich., since 1946, he graduated from Purdue University in 1942 with a B.S. in metallurgical engineering . . . Following graduation he went to work for Dow.

R. L. Farabee

Ray L. Farabee (*New Centrifugal Process Produces Soil Pipe,* page 134) has had extensive experience in both the industrial and educational phases of metallurgical engineering . . . now vice-president of The Central Foundry Co., Holt, Ala., he was born in Coal City, Ala., in 1900 . . . B. S. in chemical engineering, 1922, University of Alabama . . . M. S., metallurgical engineering, 1928 . . . M. S., chemical engineering, 1937 . . . While attending school he worked in various departments of Gulf States Steel Co. . . . With Central Iron & Coal Co., Holt, Ala., as chemist for one year . . . Returned to Gulf States Steel as metallurgist from 1922 to 1924 . . . Appointed research metallurgist of the Alabama School of Mines in 1924 . . . Joined the staff of the University of Alabama in 1926 as assistant professor of metallurgy and taught at that institution for a number of years, taking two leaves of absence to instruct at Purdue University . . . He is a member of A.F.A., ASM, the American Iron and Steel Institute and the British Institute of Metals.

H. E. Elliot

H. E. Elliot, co-author with J. G. Mezoff of *Gating System Designs Affect Pouring Rates,* page 107, is a graduate of Carnegie Institute of Technology . . . After receiving a B.S. degree in chemical engineering in 1943, he began his industrial career with Dow Chemical Co., Midland, Mich., as research metallurgist . . . Since 1946 he has been foundry metallurgist at the Bay City plant . . . Mr. Elliot has collaborated with Mr. Mezoff in writing four papers for A.F.A. . . . Two will be presented at the 1948 A.F.A. Convention in Philadelphia.

H. A. Schwartz

An international authority on malleable iron, H. A. Schwartz, co-author of *Alloying Elements Effect On Tensile Properties of Malleable Iron,* page 130) is the recipient of A.F.A.'s John A. Penton Gold Medal (1930) and of the Institute of British Foundrymen's E. J. Fox Gold Medal (1939) . . . Delivered the 1945 A.F.A. Hoyt Foundation Lecture and will go to England in June to give the 10th Edward Williams Lecture of the IBF . . . Born in Oldham County, Ky., in 1880 . . . Holder of three degrees from Rose Polytechnic Institute—B.S., 1901; M.S., 1903; and M.E., 1905—he was honored by that institution with an Sc.D. . . . Dr. Schwartz began as draftsman with National Malleable Castings Co., Indianapolis, in 1902, and later became assistant superintendent . . . Appointed director of research for National Malleable Steel and Castings Co., Cleveland in 1920 . . . Widely-known for his many papers presented before technical societies, Dr. Schwartz is a member of A.F.A., ASM, AIMME, ASTM, SAE and the Iron and Steel Institute (British).

D. Van Order

A member of A.F.A. Steel Founders Society of America, Dean Van Order (*Grinding Standards Help Eliminate Cleaning Room Bottlenecks,* page 125) has been industrial engineer with the Burnside Steel Foundry, Chicago since 1935 . . . Born November 27, 1914 in Omaha, Neb., he attended Lewis Institute, Armour Institute of Technology, and Northwestern University.

H. Morrogh

Winner of the 1947 Carnegie Gold Medal of the British Iron and Steel Institute for his outstanding work in metallurgical research is England's H. Morrogh, author of *Nodular Graphite Structures Produced in Gray Cast Irons,* page 91 . . . Born in Birmingham, England, in 1917 . . . He joined the British Cast Iron Research Association in 1933, and was placed in charge of the metallurgy department two years later . . . Appointed senior research officer of the Association in 1942 and senior research manager in 1945 . . . Mr. Morrogh is currently conducting research into the mechanism of the solidification of cast irons.

M. M. Siqueira

One of A.F.A.'s Brazilian members, Mauricio Martins Siqueira (*Brazilian Foundry Produces Chilled Car Wheels,* page 150) is chief engineer of "Sofunge" (Technical Society of General Foundries, Brazil) . . . Born in Sao Paulo in 1918 . . . Graduated from the Colegio Archdiocesano de Sao Paulo in 1935 . . . Received his degree in civil engineering from the Escola Polytecnica de Universidade de Sao Paulo in 1943 . . . Joined the Alnorma de Maquinas as a laboratory assistant in 1943 . . . Accepted a similar position with "Sofunge" the same year . . . Appointed Chief Engineer in 1946 . . . He is a member of the Associacao Brasiliera de Metaes.

J. A. Wettergreen

John A. Wettergreen (*Electrochemical Cleaning of a Large Steel Casting—An Experiment,* page 120) is assistant superintendent, foundries and pattern division, General Electric Co., Schenectady, N.Y. . . . Born in Southboro, Mass., in 1905 . . . B. S. in civil engineering from University of New Hampshire, 1930 . . . Joined the Bucyrus Erie Co., Milwaukee, . . . He became superintendent of foundries before joining General Electric in 1942 . . . Mr. Wettergreen has written for the foundry trade press and in 1946 presented a paper on turbine castings at the Philadelphia Foundry Conference.

C. A. Sanders

A strong advocate of the distribution of sand on five adjacent screens, as opposed to the more widely used three-screen sand, C. A. Sanders (*Controlling Sand Distribution Reduces Steel Foundry Costs,* page 142) is known for his booklet, *Foundry Sand Practices,* and for his many appearances as technical speaker at A.F.A. chapter meetings . . . A graduate of Ohio State university, he collaborated with Wilbur Stout, Ohio state geologist, on the development of Ohio clays . . . He joined the American Colloid Co. in 1941, after working for the Lawrence Clay Co. . . . Commissioned in the Navy, he studied rocket warfare at California Institute of Technology . . . Later saw active service in both the Atlantic and Pacific.

George Halbart

George Halbart, manager of Les Fonderies Magotteaux, Vaux - Les - Liege, Belgium, describes the casting of grinding balls and chilled car wheels in his article, *Belgian Foundry Produces Wear Resistant Cast Iron,* page 140 . . . Born in Liege, Mr. Halbart graduated from the Technical College, Liege University, in 1932 with a civil engineering degree . . . From 1933 to 1940 he was metallurgist for the foundry he now manages . . . Author of papers on martensitic and high strength cast irons, cast iron rolls, and the Maurer diagram, (see TRANSACTIONS OF A.F.A., vol. 54, p. 856, 1946), he has also written a book—*Mathematical Theory of Casting and Solidification in the Mold* . . . Mr. Halbart is a member of the A.F.A., ASM, the Belgian Foundrymen's Association for which he is chairman of the scientific commission, and Liege University Engineers' Association.

Robert W. K. Honeycombe

Author of the 1948 exchange paper of the Institute of Australian Foundrymen, *Copper-Lead Alloys,* page 113, 27-year-old Robert W. K. Honeycombe received his B. Sc. from the University of Melbourne and in 1942 was awarded an M. Sc. with first class honors in metallurgy for his work on the properties of tungsten carbides . . . His discovery of a significant difference in the behavior of lead and tin-base bearing alloys won for him an Imperial Chemical Industries scholarship to Cambridge University.

W. K. Bock, resident engineer, National Malleable and Steel Castings Co., Cleveland, is co-author with H. A. Schwartz of *Alloying Elements Effect On Tensile Properties of Malleable Iron,* page 130 . . . Born December 17, 1908, Dayton O. . . . Attended Case Instittue of Technology, receiving a B.S. in 1931, M.S., 1935, and metallurgical engineering degree in 1938 . . . Joined Bishop & Babcock Manufacturing Co., Cleveland, as metallurgist in 1931.

Illustrating the various phases of foundry operation, from raw materials to finished castings, this exhibit of the Bignall Co. stimulated public interest at the recent Medina, N.Y. Exposition. Featured in the display were the quantities of raw materials required to produce 1000 lb castings, cutaway molds in various casting production stages, and the final, finished products. Copies of the A.F.A. publication THE FOUNDRY IS A GOOD PLACE TO WORK, were distributed.

CHAPTER ACTIVITIES NEWS

Texas

W. H. Lyne
Hughes Tool Co.
Publicity Chairman

MEMBERS OF THE TEXAS CHAPTER met in Beaumont on January 23 to hear L. P. Robinson, director of core oil sales, Werner G. Smith Co., Cleveland, give a talk on "Variables in the Core Room—Their Treatment and Cure."

Mr. Robinson pointed out there are eight variables which may occur in the manufacture of cores, namely: (1) type of sand used; (2) binders; (3) ratios; (4) mixing and mulling; (5) moisture content; (6) baking; (7) venting; (8) inspection.

He discussed the use of various types of sand for the making of cores and indicated a definite need for a foundry to standardize on a good sand which meets its requirements. Only the amount of cereal binder needed for adequate green strength should be added to the core mix, he said. The ratio of the mixture is a variable which may cause foundries serious trouble, especially if volume measurements are used, and Mr. Robinson recommended that all mixtures be prepared by weight in order to maintain constant ratios.

Mixing and mulling time were discussed and it was pointed out that if core mixtures are mulled too long their strength decreases, therefore some foundries have time switches to control the mixing time.

The percentage of moisture in the core sand mixture is also a variable and should be controlled depending on the type of core operation used.

Variables of baking cores were discussed and it was mentioned that core oil manufacturers should advise their customers at which temperature cores from their oils should be baked. High baking temperatures may lead to surface hardening without proper interior baking.

The necessity for proper venting of cores was brought out. Many operators vent cores but do not provide an outlet through the mold for the escape of core gases, said Mr. Robinson. In covering core inspection, he indicated that many foundries have shown definite savings by the inspection of cores before they are set in molds, thereby eliminating the pouring of metal around cores which are not satisfactory and which may lead to scrap castings.

Central Ohio

H. W. Lownie, Jr.
Battelle Memorial Institute
Chapter Reporter

THE JANUARY 26 MEETING of the Central Ohio chapter featured a motion picture showing the modernization of the Moline Malleable Iron Co., St. Charles, Ill. The "before and after" situations existing at this foundry were shown in the movie, and the effect of newly installed modern mechanical equipment in improving working conditions was well illustrated.

In discussing the picture, R. L. McIlvaine, National Engineering Co., Chicago, stated that modernization of a foundry requires a lot of planning beforehand in order to insure the installation of a correlated and efficient group of units. The installation of a number of new mechanical units may fail to give the desired results, even though each unit may individually be effective, if the over-all picture is not given adequate consideration.

G. K. Dreher, executive director, Foundry Educational Foundation, Cleveland, discussed the activities of the Foundation and emphasized the need for trained personnel in the foundry industry.

Central Illinois

V. W. Swango
Caterpillar Tractor Co.
Chapter Reporter

REVERSING THE ADAGE that "too many patternmakers have never seen the inside of a foundry" to "too many foundrymen have never seen the inside of a pattern shop," V. J. Sedlon, president, Master Pattern Co., Cleveland, told Central Illinois

National Director J. E. Kolb, Caterpillar Tractor Co., Peoria, Ill. (right) chatting with V. J. Sedlon, Master Pattern Co., Cleveland, at the February 2 meeting of the Central Illinois chapter.

Participants in the January 16 meeting of the Birmingham District chapter. Left—Chapter Vice-Chairman and Program Chairman Dr. J. T. MacKenzie, American Cast Iron Pipe Co., Birmingham, and speaker B. P. Mulcahy, consulting engineer, Indianapolis. Right—Chapter Director and Educational Committee Chairman C. P. Caldwell, Caldwell Foundry & Machine Co., Birmingham, and Professor E. C. Wright, University of Alabama.

chapter members that foundrymen need a better understanding of how patterns are made, and a better understanding of the basic problems of the patternmaker. This chapter meeting was held February 2 at the Jefferson Hotel, Peoria, Ill. National Director J. E. Kolb, Caterpillar Tractor Co., Peoria, acted as technical chairman.

In discussing costs, Mr. Sedlon remarked that cutting down pattern cost to the point of increasing the casting cost is false economy. It is just as foolish to make an elaborate metal pattern to produce fifty or sixty castings as it is to make loose wood pattern equipment to produce a thousand castings. The speaker said it is impossible to set up hard and fast rules for selecting the proper kind of pattern; each one must be handled individually—it must fit the job it is to do. It must be remembered in selecting pattern equipment that the cost of the pattern is controlled by the hours put into it and not by the material, Mr. Sedlon said.

Western New York

J. R. Wark
Queen City Sand & Supply Co.
Chapter Director

Sixty persons were present at the Western New York chapter meeting held February 6 at the Hotel Touraine, Buffalo. Chapter Chairman Elliott R. Jones, Lumen Bearing Co., Buffalo, presided. Technical chairman was M. T. MacPherson, foundry engineer, Symington-Gould Corp., Depew, N.Y. Principal speaker was National Director-elect N. J. Dunbeck, Eastern Clay Products Inc., Jackson, Ohio.

Chemically bonded molding sands were discussed and were compared with ordinary molding sands. The use and characteristics of both types were discussed and a number of advantages for using the new type molding sand were mentioned.

Marked reductions in scrap losses, rapid cleaning and finishing, low clay and water, rapid mixing and high permeability and flowability were cited.

Ontario

R. C. Tiplady
Westman Publications, Ltd.
Chapter Reporter

Under the chairmanship of Jim Dalby, Wilson Brass & Aluminum Foundries, Toronto, the Ontario chapter held National Officers Night at the Royal Connaught Hotel, Hamilton, January 30.

The first speaker of the evening was National Director E. N. Delahunt, Warden King Ltd., Montreal, who spoke briefly about the 1948 convention and the plans for a Canadian dinner instead of the usual luncheon. The date for this event is Wednesday, May 5.

National Vice-President and President-elect W. B. Wallis, Pittsburgh Lectromelt Furnace Corp., Pittsburgh, Pa., spoke on the activities of the Association. He also commented upon his recent trip abroad and the high esteem accorded the A.F.A. by foreign foundrymen.

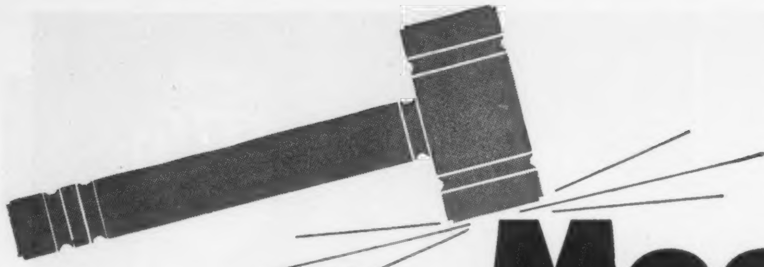
H. F. Scobie, in charge of educational activities for A.F.A., was the third speaker. He urged members of the audience to individually and collectively do a public relations job of their own to educate the public to the importance of cast metals.

Birmingham District

J. P. McClendon
Stockham Pipe Fittings Co.
Publicity Chairman

One of the finest meetings of the Birmingham District chapter was held January 16 at the Tutwiler Hotel, Birmingham, and attracted 125 members and guests. E. C. Wright, professor, school of metallurgy, University of Alabama, University, was the coffee talker and the technical session featured B. P. Mulcahy, consulting engineer and coke expert of Indianapolis.

Professor Wright outlined four ways in which the Birmingham chapter could help the university to interest the college student in a course in foundry practice. He pointed out the need for students who will be prospective foundrymen. He encouraged foundries to interest high school students in the industry. The second point stressed was the need for laboratory equipment for student use. A third means of cooperation would be the submission of practical foundry or metallurgical problems, on which students could work and possibly prepare their theses. Finally, the industry could interest the students by giving them jobs during the



Chapter Meetings

APRIL 15

DETROIT
Rackham Memorial
JOSEPH L. DOSTAL
Permold Foundry
"Permanent Mold Castings"
BROCK PICKETT
Unitcast Corp.
"Quality Control in the Steel Foundry"
LEO A. BEHRDT
Joseph Dixon Crucible Co.
"Crucibles in Foundry Work"

APRIL 16

E. CANADA & NEWFOUNDLAND
Mount Royal Hotel, Montreal
ANNUAL SMOKER

NORTHERN CALIFORNIA
Lake Merritt Hotel, Oakland
PHIL MCCAFFERY
General Metals Corp.
"Casting Defects as Result of Gas"

TEXAS
NATIONAL OFFICERS' NIGHT
A.F.A. National President
MAX KUNIANSKY
National Director
J. H. SMITH
ANNUAL BARBEQUE

WASHINGTON
Gowman Hotel, Seattle
ELECTION OF OFFICERS
MOVIE—*Deep Sea Salvage*

APRIL 19

QUAD CITY
Ft. Armstrong Hotel, Rock Island
T. R. GAUTHIER
Aluminum Co. of America
"Casting of Aluminum Alloys"

APRIL 20

BRITISH COLUMBIA
Medical Dental Auditorium
THOMAS COWDEN
Wm. McPhail & Sons Foundry
PANEL DISCUSSION—*"Molding Practice"*

CENTRAL MICHIGAN
Schuler Hotel, Marshall
V. J. SEDLON
Master Pattern Co.
"Patternmaking"

EASTERN NEW YORK
Circle Inn, Albany
W. B. GEORGE
R. Lavin & Sons Co.
"General Nonferrous Practice"

APRIL 22

TOLEDO
Maumee River Yacht Club
JOINT MEETING WITH ASM
WILLIAM J. PHILLIPS
Steel Founders' Society of America
"Recent Developments in the Steel Castings Industry"

APRIL 23

BIRMINGHAM DISTRICT
Tutwiler Hotel, Birmingham
ARTHUR A. CLAY
Cost Consultant
"Foundry Costs"

CHESAPEAKE
Engineers Club
H. M. ST. JOHN
Crane Co.
"Bronze Pressure Castings"

APRIL 26

CENTRAL OHIO
Chittenden Hotel, Columbus
HARRY W. DIETERT
Harry W. Dietert Co.
"Sand Properties"

NORTHWESTERN PENNSYLVANIA
Moose Club, Erie
M. T. MACPHERSON
Symington-Gould Corp.
"Steel Foundries"

MAY 3

CENTRAL ILLINOIS
Jefferson Hotel, Peoria
J. A. DURR
Albion Malleable Iron Co.
"Malleable Foundry Practice & Recent Developments"

MAY 6

SAGINAW VALLEY
Fisher Hotel, Frankenmuth
PETER MARTIN
Koppers Co., Inc.

MAY 7

MEXICO CITY
Casa Jalisco
BUSINESS MEETING

MAY 10

CINCINNATI DISTRICT
C. A. BRASHARES
Harbison Walker Co.
"Refractories"

WESTERN MICHIGAN
Schuler Hotel, Grand Haven
L. L. CLARK
Buick Motor Co.
"Cupola Operation"

MAY 11

NO. ILLINOIS-SO. WISCONSIN
Beloit Country Club, Beloit
OLD TIMERS' NIGHT
B. D. CLAFFEY
General Malleable Corp.
"Youth Encouragement"

ROCHESTER
Seneca Hotel
MICHAEL BOCK
Exomet, Inc.
"Shrinkage Problems"

MAY 13

NORTHEASTERN OHIO
Cleveland Club, Cleveland
OLD TIMERS' NIGHT
ELECTION OF OFFICERS

ST. LOUIS
NATIONAL OFFICERS' NIGHT
A.F.A. National President
MAX KUNIANSKY

MAY 14

CENTRAL NEW YORK
Onondaga Hotel, Syracuse
NORMAN SMITH
Link Belt Co.
"Mechanization"

E. CANADA & NEWFOUNDLAND
Mount Royal Hotel, Montreal
ELECTION OF OFFICERS
PRESENTATION OF PRIZES TO COMPETITION WINNERS

WESTERN NEW YORK
Hotel Touraine, Buffalo
CONVENTION HIGHLIGHTS
P. E. KYLE
Cornell University
"Training Foundry Engineers"

WISCONSIN
Hotel Schroeder, Milwaukee
OLD TIMERS' NIGHT

MAY 17

QUAD CITY
Fort Armstrong Hotel, Rock Island
NATIONAL OFFICERS' NIGHT
A.F.A. National President
MAX KUNIANSKY

MAY 20

TWIN CITY
Covered Wagon, Minneapolis
KENNETH H. PRIESTLEY
Vassar Electroloy Products, Inc.
"Properties and Control of Electric Furnace Iron."

summer months when they are not in school and need work.

Mr. Mulcahy proved to be one of the most interesting speakers to appear before the chapter. He was well versed in his subject "Foundry Coke and Cupola Operations" and his presentation through the use of slide films was very effective.

Southern California

R. R. Haley
Advance Aluminum & Brass Co.
Chapter Reporter

CORES BAKED ELECTRONICALLY in 40 seconds! That was the story told to Southern California chapter members and guests by J. W. Cable, director of research and sales, Induction Heating Corp., Brooklyn, N.Y., at the January 23 meeting held in Rodger Young Auditorium, Los Angeles. He explained the difference between drying in a conventional oven and baking automatically. In the older method, drying starts at the outside, whereas in the newer, the cores are heated uniformly throughout.

Dielectric heating, according to Mr. Cable, is obtained by placing materials having poor thermal conductivity, such as wood, sand, etc., in a rapidly alternating electrical field between two parallel steel plates. Under the stress of the imposed voltage, the molecules of the materials tend to deform. The resistance of the molecules to this deformation consumes energy which appears as heat in the material.

The problem of obtaining a suitable binder that would set at a definite temperature was solved by using synthetic resins such as phenol-formaldehyde or urea-formaldehyde. A core mixture using such a binder, sand and water sets at about 275-300 F. After baking, the binder is no longer water soluble. Because of encrustation and the danger of overbaking, binders of this type cannot be dried in conventional ovens.

The collapsibility of cores made with plastic binders is exceptionally good. This is due to the fact that the binder breaks down at about 600 F to a white powder.

Although horizontal metal wires or rods are not harmful, vertical metal wires and rods cannot be used in cores for dielectric baking. The metal distorts the electrical field and prevents baking. However, wood may be used successfully.

Metal cannot be used for core driers. This was a serious obstacle to the more general use of a dielectric oven. Fortunately, it has been found that satisfactory cores can be made in plastic driers having a dielectric similar to sand. According to Mr. Cable, cores made in such driers can be held within a tolerance of 0.002 in.

The many questions that followed Mr. Cable's talk attested to the large amount of interest in the new method of making cores. The fact that the volume of gas given off during baking in a dielectric oven is only one-thirtieth of that from a conventional oven was of particular interest to many because of the attention now being given to smoke and fume control in an effort to make the foundry a better place to work.

Ohio State University

Eldon Boner
Industrial Engineering Student
Secretary-Treasurer

THE MARCH 6 MEETING featured an address on "Foundry Coke Characteristics," in which H. W. Lownie, Jr., Battelle Memorial Institute, analyzed national coal and coke production and consumption, particularly with relation to the foundry industry, which consumes almost 30 per cent of the nation's inadequate coke supply.

In discussing coke testing methods Mr. Lownie stated that although foundries run exhaustive tests, they cannot predict fully the reactions of coke in the cupola. This is apparently due to the great number of

Left—J. W. Cable (left), Induction Heating Corp., Brooklyn, N.Y., giving some pointers to Chapter Secretary J. E. Wilson, Climax Molybdenum Co., Los Angeles, on core baking. Right—(starting left) O. J. Stoudt, Brumley Donaldson Co., Huntington Park, Calif.; C. E. Hurray, Jr., Commercial Enameling Co., Los Angeles; E. C. Heyde, Apex Steel Corp., Los Angeles; H. G. Pagenkoff, Angelus Pattern Works, Huntington Park; Chapter Treasurer E. D. Shomaker, Kay-Brunner Steel Products, Alhambra.

variables. Mr. Lownie is currently engaged in research on how to produce coke to exact specifications so that foundries will have advance knowledge of its combustion characteristics in the cupola.

Today's coke does not measure up to the high quality of prewar coke, Mr. Lownie said, because high-quality coking coals are not available. In consequence, new methods of using coke must be developed to maintain efficient cupola operation.

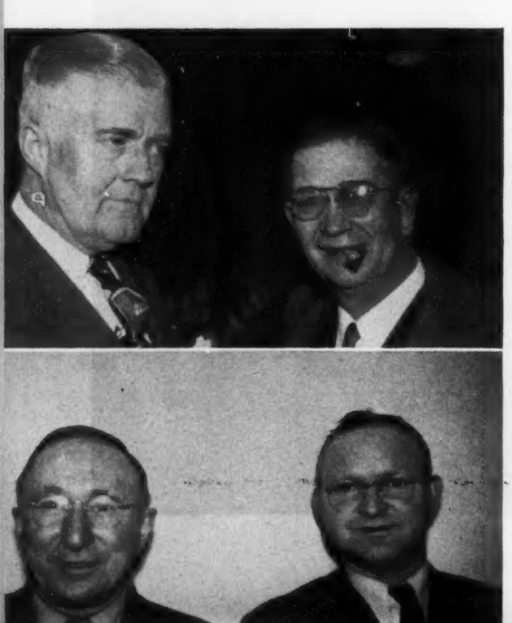
Oregon

W. R. Pindell
Northwest Foundry & Furnace Works, Inc.
Chapter Director

THE CHAPTER MET on February 19 in the Heathman Hotel, Portland, and held the customary dinner and technical meeting. Chapter Program Chairman R. A. Bremmer, Electric Steel Foundry Co., Portland, introduced the speaker of the evening, O. H. Rosentreter, Los Angeles, west coast district manager, National Engineering Company. Subject for discussion was "Sand Conditioning Units."

The speaker showed a motion picture of a large foundry and the modern methods employed in sand handling, molding, pouring and shakeout. He then presented a number of slides illustrating equipment adaptable to smaller foundry plant operation.

(Starting left) H. J. Pfeiffer, Jr., Electro Metallurgical Sales Corp., Chicago; guest speaker W. B. McFerrin, Electro Metallurgical Co., Detroit; and Chapter Chairman R. W. Trimble, Bethlehem Supply Co., Tulsa, Okla., discussing the program of the Tri-State chapter's February 20 meeting in Tulsa.



Present at the February Tri-State chapter meeting held in Joplin, Mo., were: Top—(left) Chapter Director and Chairman, Membership Committee B. P. Glover, M. A. Bell Co., Tulsa, Okla., and Clyde Beagle, Webb Corp., Webb City, Mo., a program committee member who helped arrange the meeting. Bottom—(left) Chapter Director C. H. Bentley, Webb Corp., and Chapter Treasurer F. G. Lister, Chicago Pneumatic Tool Co., Tulsa.

Each sand conditioning plant should be custom built to suit the conditions in each plant, he said. The basic requirements of a good sand system were enumerated as follows: (1) separate all magnetic materials from the sand; (2) screen out all refuse; (3) exhaust the fines; (4) cool the shakeout sand; (5) mull well; (6) aerate the mulled sand; and (7) distribute properly to molding stations. A good sand conditioning plant will pay for itself in a period of time by (1) allowing unskilled labor to operate the system; (2) better castings will result from using uniform facing and heap sand; (3) sand, costly on the west coast, will be saved.

Tri-State

F. E. Fogg
Acme Foundry & Machine Co.
Publicity Chairman

A CAPACITY CROWD turned out for the February 20 meeting held in Joplin, Mo. Technical speaker, W. B.McFerrin, Electro Metallurgical Sales Co., Detroit, gave a timely and informative talk on alloy steels and cast irons. The speaker made reference to various late silicon alloy additions for gray iron and answered many questions from the audience upon the conclusion of his talk.

Chapter Chairman R. W. Trimble, Bethlehem Supply Co., Tulsa, Okla., presided. Chapter Directors C. H. Bentley and C. C. Beagle, The Webb Corp., Webb City, Mo., made the arrangements for the meeting.

Twin-City

O. J. Meyers
Werner G. Smith Co.
Chapter Secretary

THE MARCH 4 MEETING, attended by more than 200 foundrymen and their guests, featured an address and demonstration by S. D. Martin and S. W. Healy, Central Foundry Division, General Motors Corp.

Mr. Martin and Mr. Healy discussed General Motors' better methods department, created to improve working conditions and alleviate fatigue among foundry personnel. In 1934, motion study training was instigated by this organization and since that time all key personnel have been instructed.

Two examples of improvement in foundry output through the use of motion study were illustrated. By changing from a single file to a gang file and by the employment of both hands "usefully," it was shown that the cleaning and dipping of cores could be achieved

with less fatigue and at a much greater production rate. The second example demonstrated that core production could be raised from 480 per hour to 780 per hour by proper arrangement of tools and materials.

A motion picture taken in a General Motors foundry compared old and new methods of production under actual foundry conditions. The use of double match plates, mechanical weight shifters, elevated tumbler mills and double box blowing was portrayed.

The discussion period following the motion picture lasted more than an hour and was very informative.

Canton District

Nils E. Moore
Wadsworth Testing Laboratory
Chapter Reporter

A PREDICTION WAS MADE by Thomas W. Curry, Lynchburg Foundry Co., Lynchburg, Va., that future developments in chemically bonded sand will greatly reduce production costs in the foundry. This statement was made February 12 at the Canton District chapter meeting. Mr. Curry went on to say that the improved molding sand will produce castings requiring less cleaning and bring them nearer to the required dimensions. Grains of sand treated with synthetic resin produce a molding sand of greater plasticity than is now generally used, he said.

Central New York

J. A. Feola
Crouse-Hinds Co.
Publicity Chairman

EIGHTY MEMBERS AND GUESTS attended the February dinner and technical meeting of the chapter held in the Onondaga Hotel, Syracuse, N.Y. Vice-Chairman C. M. Fletcher, Fairbanks Co., Binghamton, N.Y., presided and introduced the speaker, Dr. Laverne W. Eastwood, supervising metallurgist, Battelle Memorial Institute, Columbus, Ohio, who spoke on the subject: "Casting Unsoundness Caused by Gas Evolution."

Dr. Eastwood explained casting unsoundness caused by gas evolution from the melt during solidification in the mold which is a problem common in the founding of all metals. Furthermore, according to the speaker, the methods of avoiding gas absorption, the possible methods of degassing melts, the two types of gas evolution, and the two

L. P. Robinson, Werner G. Smith Co., Cleveland, gives the latest core oil information before the January meeting of the Canton District chapter starts. Standing (starting left) Dr. D. C. Williams, Ohio State University, Columbus, Ohio; Lemar Jones and Chester Williams, Massillon Steel Castings Co., Massillon, Ohio; and Mr. Hess, Hess-Snyder Co., Massillon. Sitting (starting left) Pat Dwyer, Penton Publishing Co., Cleveland; Chapter Chairman F. C. Bunting, Pitcairn Co., Barberton, Ohio; Mr. Robinson; and Chapter Treasurer Otis Clay, Tuscora Foundry Sand Co., Canal Fulton, Ohio. For report of this meeting see AMERICAN FOUNDRYMAN *for March, 1948.*

Above—E. C. Hoenicke, Eaton Mfg. Co., Detroit talking on permanent mold gray iron castings at the February 9 meeting of the Cincinnati District chapter.

types of unsoundness caused by gas evolution are generally similar in all common casting alloys.

The two types of gas evolution are: (1) gas precipitates as a result of decreased solubility when the metal changes from a liquid to a solid, and (2) oxygen in solution in the melt reacts with a second constituent, such as hydrogen, carbon, or sulphur, to form a fairly insoluble compound such as H_2O, CO, or SO_2. Because oxygen is not appreciably soluble in aluminum and magnesium melts, type 2 gas evolution is not important.

The types of gas unsoundness are (1) pin holes or gas holes, and (2) microporosity. The first type may occur in all casting alloys, whereas the second is more common in solid-solution alloys. Examples of both types of gas unsoundness in various common casting alloys were shown.

Cincinnati District Chapter

C. H. Fredricks
Cincinnati Milling Machine Co.
Chapter Reporter

SPEAKING at the February 9 session, held at the Engineering Society Headquarters, E. C. Hoenicke, general manager of the Foundry Division, Eaton Manufacturing Co., Detroit traced the development of methods and equipment in the permanent mold process for producing iron castings.

Emphasizing the fact that perma-

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Secretary-Treasurer, Martin J. O'Brien

◄ 4

nent mold gray iron castings are only applicable to a limited field, Mr. Hoenicke pointed out that they have four valuable qualities: free machineability; dense structure; close size limits, no growth or distortion; and ability to take a high finish.

The maximum weight of a single casting is ten pounds, Mr. Hoenicke stated, and the section thickness is limited to 1¼ in. maximum. Only the type of iron that has a tensile strength of 30,000 pounds per square inch is used. The quality and dimensional accuracy of a permanent mold casting is something that the average sand casting foundry can only hope to approach, Mr. Hoenicke concluded.

The Eastern Canada-Newfoundland chapter had E. T. Kindt, Kindt-Collins Co., Cleveland, as its speaker for the meeting of February 13.

E. Canada & Newfoundland
H. E. Francis
Jenkins Bros. Ltd.
Chapter Director

AN INFORMATIVE LECTURE on "Past and Present Trends of the Pattern Industry" was given February 13 before the chapter by E. T. Kindt, Kindt-Collins Co., Cleveland. The largest audience of the year, 160 members and guests met at the Mount Royal Hotel, Montreal. The crowd included many trade school boys, apprentices, and patternmakers.

The speaker divided his paper into four parts: (1) the selection of

(Continued on Page 178)

New AFA MEMBERS

Period February 15 - March 15: New A.F.A. members during this period number 366. Of 38 chapters registering membership gains, the leaders are: Tennessee (recently formed), 55; Birmingham, 25; Chicago, 25; Massachusetts Institute of Technology, 25; Missouri Mines, 23; Detroit 21.

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A. J. Kiesler, Fdry. Met., General Electric Co., Schenectady.
M. J. McCann, Frm., Chip & Clean. Dept., Rensselaer Valve Co.
B. G. Meyer, Frm., C.R., Rensselaer Valve Co.
C. G. Stiles, Dist. Sales Mgr., Car-Mor Metal Co., Philadelphia.
H. J. Watson, Frm., Rensselaer Valve Co.
H. R. Williams, Frm., General Electric Co., Schenectady.

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E. W. Doe, Chairman, Metal Shops Dept., Brooklyn Technical High School
M. C. Knight, Dist. Sales Mgr., Swan-Finch Oil Corp., New York.
P. F. Maurer, Sales Engr., Pangborn Corp., New York.
J. I. Medoff, Student, Jelenko School for Precision Casting, New York.
James F. Salmon, Jr., Asst. Frm., Fdry. Dept., International Nickel Co., Inc., Bayonne Works, Bayonne, N.J.

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Alberto Cervantes Beltran, Quimico Ensayador Metalurgista, Hierro Maleable De Mexico S. de R. L., Pedro de los Pinos, Mexico.
Juan De Luca, Prop., Deposito de Metales "Aldaco" Mexico, D.F.

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J. N. Eckroth, Appr., Eberhard Mfg. Co. Div., Eastern Malleable Iron Co.
Finley Edmonson, Plant Insp., The Lake City Malleable Co., Cleveland.
R. K. Kelly, Appr., Eberhard Mfg. Co. Div., Eastern Malleable Iron Co.
L. J. Petro, Estimator, The Lake City Malleable Co., Cleveland.
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Carl Winkler, Gen. Mgr., Cleveland Standard Pattern Works, Inc.

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C. C. Taccone, Drafting Trainee, General Electric Co., Erie, Pa.

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C. V. Emmons, Owner & Mgr., C & B Products Co., Toronto, Ont.
L. Humphreys, A. H. Tallman Bronze Co. Ltd., Hamilton, Ont.
Joseph Lee, Fdry. Frm., Thompson Products Ltd., St. Catharines, Ont.
E. N. Noseworthy, Asst. to Pres., Smiths Falls Malleable Castings Ltd., Smiths Falls, Ont.
F. J. Walker, Providor (Foundry), Dominion Foundry & Steel Ltd., Hamilton.
Peter White, Massey-Harris (Verity) M Foundry, Brantford, Ont.
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D. W. Sheahan, Chemist, J. I. Case Co., Bettendorf, Iowa.

*Company Members.

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Edward P. DeWanz, Clng. Rm. Supt., Duncan Foundry & Machine Works.
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Peter R. Rofferty, Pres., Parco Supplies, St. Louis, Mo.
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William Moss, Prod. Control Supv., Compton Foundry, Compton, Calif.
E. B. Moritz, Owner, E. B. Moritz Foundry, Santa Ana, Calif.
K. S. Moritz, Mgr., E. B. Moritz Foundry, Santa Ana, Calif.

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***Columbian Iron Works, Chattanooga. (O. E. Walker, Vice Pres. & Plant Mgr.).**
***Eureka Foundry Co., Chattanooga. (W. P. Delaney, Jr., Gen. Mgr.).**
***Southern Skein & Foundry Co., Chattanooga. (H. V. Mann, Pres. & Gen. Mgr.).**
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Matthew Seaman, M.Sc., M.I. Mech. E., M.I.P.E., Dire. & Gen. Mgr., P. R. Jackson & Co., Ltd., Manchester.

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National de la Recherche Scientifique, Paris 5.

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Koros Bela, Weiss Manfred Steel & Metal Works, Ltd., Budapest.
Wilhelmb Tibor, Weiss Manfred Steel & Metal Works, Ltd., Budapest.

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B. Gill, Engrg. Dept., Delhi Cloth & General Mills Co., Ltd., Delhi.

Norway

Alf Ihlen, Pres., Mg. Dir., Strommens Varnksted, Strommen Station.

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West Indies

J. A. Jones, 10A Ocean View Ave., Bournemouth Gardens, Kingston, Jamaica.

Chapter Helps Organize New Council

SECRETARY OF THE NEWLY FORMED Southern California Technical Societies Council is John E. Wilson, Climax Molybdenum Co., Los Angeles, who is also secretary of the Southern California Chapter of A.F.A. Alternate delegate to the council is Chapter Vice-President L. O. Hofstetter, Brumley-Donaldson Co.

Expected to represent over 10,000 persons, the council was organized to coordinate the activities of local engineering, technical, and scientific societies in the interest of community benefit.

Ace Foundry, Ltd., Huntington Park, Calif., uses an airplane to locate scarce materials, to shorten travel time of company executives and engineers, and to make emergency shipments. Here a load of agricultural machinery castings is being delivered at Fresno, Calif.

MEMBERSHIP IN THE AMERICAN FOUNDRYMEN'S ASSOCIATION ADVANCES THE INDUSTRY THROUGH ADVANCEMENT OF THE INDIVIDUAL

It has been said, and wisely, that "the best form of training is the personal exchange of information from man to man"—membership in the American Foundrymen's Association provides such an exchange between men of the metal casting industry.

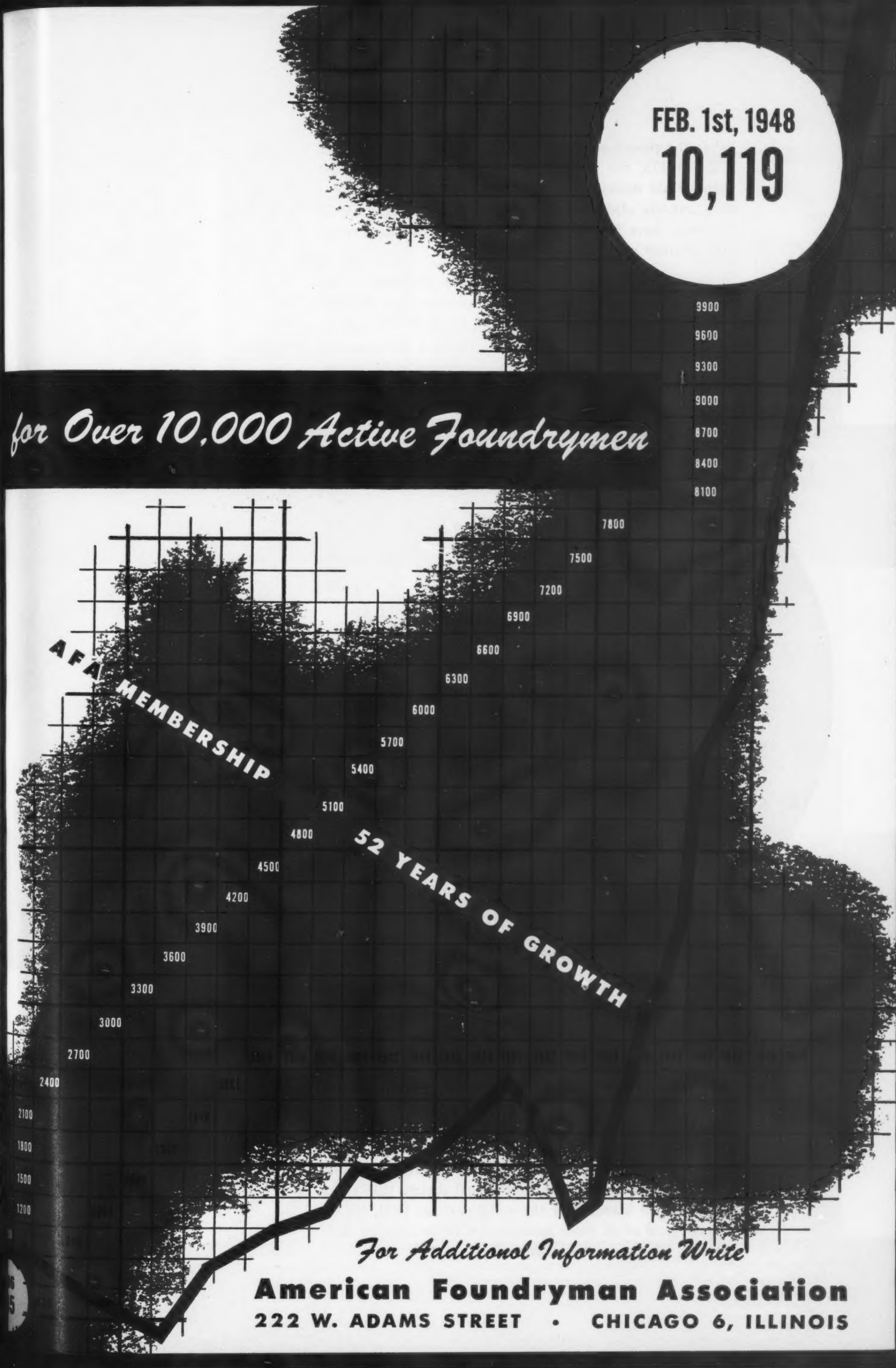
So much new information on castings production is coming to light constantly that even the most outstanding metallurgists and operating men find it difficult to keep up with scientific and engineering advancement in the foundry field. It is only through the combined information of many that the modern castings producer can meet the challenge of competitive processes and products.

To enable these men to broaden their information and usefulness is simply good business—that is why the American Foundrymen's Association invites *Management* to make sure that their key men hold membership in AFA, the technical society serving all branches of the metal castings field.

Today the activities of a plant, large or small, can be carried on adequately only if the supervisors keep abreast of developments in sand, molding, melting, cleaning and foundry control. In any company, too, there are younger men, who have come into the industry in recent years, upon whose knowledge and experience will depend the progress of individual plants.

AFA provides the membership with a constant flow of the type of practical and technical information that keeps the individual advised of modern developments and techniques . . . to advance himself and his company.

No man, no business, no industry stands still. They either go backward—or forward. The men who play an active part in AFA affairs are doing their part to keep the foundry industry going forward.


FEB. 1st, 1948
10,119
for Over 10,000 Active Foundrymen
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52 YEARS OF GROWTH
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For Additional Information Write
American Foundryman Association
222 W. ADAMS STREET • CHICAGO 6, ILLINOIS

While the growth of A.F.A. is portrayed graphically on pages 172 and 173, the Membership Chairmen of the different chapters are deserving of a vote of genuine appreciation—their untiring efforts and those of their predecessors, over the years, have figured prominently in the development of the different groups.

In most cases, the office of Membership Chairman is not an elected position—rather, it is a voluntary job that demands unceasing efforts and the will to build local groups into coordinated, strong units, motivated by a common purpose, through interesting progressive foundrymen in the

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D. C. Abbott
Hill and Griffith Co.
Birmingham

BRITISH COLUMBIA
J. S. Graham
Mainland Foundry Co. Ltd.
Vancouver, B. C.

CANTON DISTRICT
Robert A. Epps
Stoller Chemical Co.
Akron, Ohio

area in the benefits of A.F.A. to individual members . . . to the advancement of the industry as a whole.

In an effort to make sure that all of the 39 A.F.A. Chapters were included in this feature, two of the groups are represented by Chapter Chairmen, rather than official Membership Chairman. A.F.A. is proud of the work of the 39 Chapter Membership Chairmen, as well as the Chapter officers with whom they work, in helping to keep the American Foundrymen's Association the kind of technical society that serves impartially all branches of the metal castings field, for the general good of all those associated with an industry dedicated to fill the needs of mankind.

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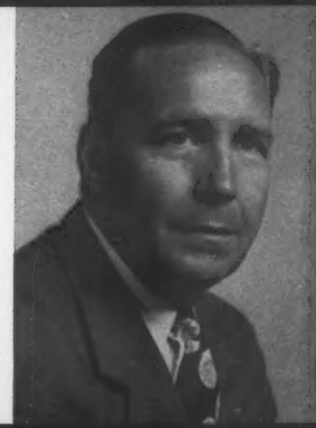
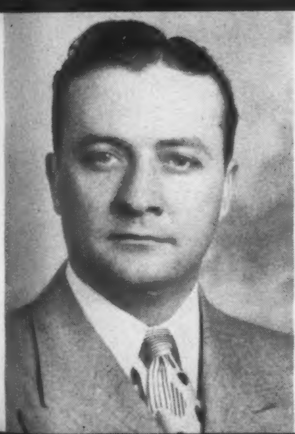
Superior Foundry Co
East Peoria, Ill.

CENTRAL INDIANA
A. J. Reid
General Refractories Co.
Indianapolis

CENTRAL MICHIGAN
Walter Millar
Battle Creek Foundry Co.
Battle Creek, Mich.

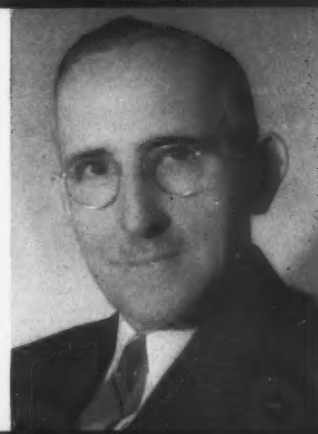


CENTRAL NEW YORK
A. C. Hintz
Hines Flask Co.
Troy, N. Y.



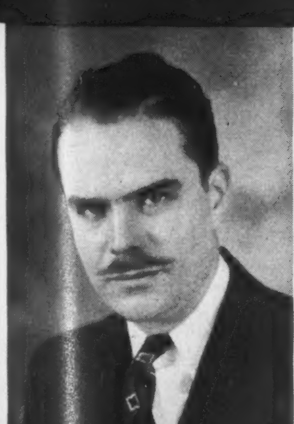
CENTRAL OHIO
T. W. Payne
Summer & Co.
Columbus, Ohio

CHESAPEAKE
J. B. Mentzer
Wood-Embly Brass Co.
Waynesboro, Pa.



CHICAGO
D. H. Lucas
Chicago

CINCINNATI DISTRICT
Robt. G. Ebersole
Miller & Co.
Cincinnati



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Vanadium Corporation
of America
Detroit

EASTERN CANADA &
NEWFOUNDLAND
W. J. Brown
Robert W. Bartram, Ltd.
Montreal, Quebec

EASTERN NEW YORK
Robt. L. Wickes
E. F. Houghton & Co.
Schenectady, N. Y.

METROPOLITAN
F. B. Eliason
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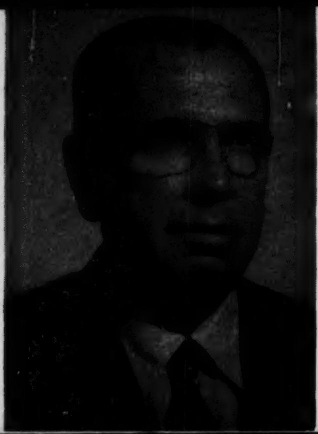

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Fundicion y Talleres
America, S. A.
Mexico, D. F.

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Elkhart Brass Mfg. Co.
Elkhart, Ind.

NORTHEASTERN OHIO
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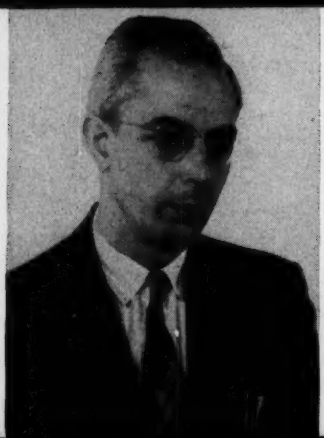
Ohio Foundry Co.
Cleveland

NORTHERN CALIFORNIA
W. W. Clark
Enterprise Engine
& Foundry Co.
South San Francisco



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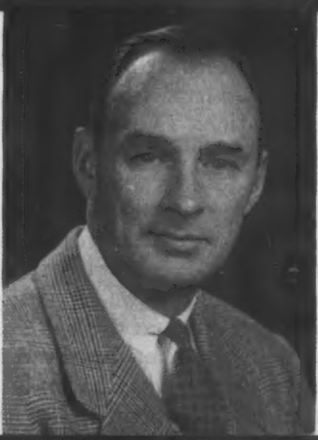
Hanna Furnace Corp.
Buffalo



WISCONSIN
S. E. Shaver
Werner G. Smith Co.
Milwaukee, Wis.

CHAPTER ACTIVITIES

(Continued from Page 168)

proper equipment and the most efficient layout for a pattern shop; (2) principles employed in figuring costs on wood and metal patterns; (3) principles employed in selling patterns and pattern equipment; and (4) the future applications of plastics and ceramics to patterns.

Northwestern Pennsylvania

Earl M. Strick, Jr.
Erie Malleable Iron Co.
Chapter Reporter

THE MONTH OF FEBRUARY was one of great activity for the Northwestern Pennsylvania chapter. Four meetings were held in this period.

On February 5, the chapter officers met with local school authorities to formulate plans for teaching the community about the foundry industry and its meaning and importance to the region.

R. L. Lee, General Motors Corp., Detroit, spoke at the February 19 meeting of the sub-group in Franklin, Pa. He discussed "Humanics—Man to Man." Mr. Lee stressed the value of more complete understanding between management and labor on common problems. He stated that a campaign for more production must carry with it an incentive for more and better work on the part of the worker. Treating the worker with respect will get the best results, he said.

This meeting was attended by 94 foundrymen of the area. Chapter Director T. H. Beaulac, Chicago Pneumatic Tool Co., Franklin, Pa., acted as chairman.

One hundred and fifty members and guests were treated to an outstanding analysis of the production of malleable iron by Carl Joseph, technical director, Central Foundry Div., General Motors Corp., Saginaw, Mich. The talk was given February 23 at the Moose Club, Erie.

Mr. Joseph told the group that with the shortage of melting materials today, careful control is necessary to produce quality castings and maintain a low scrap loss. He pointed out that there are too many deviations from the standard practices in the foundry industry and that troubles cannot be attributed to any one cause if standard practices are not set up and maintained. He also covered the various operations necessary for the manufacture of salable malleable castings and emphasized the need for bringing along men for supervisory jobs. A movie of old and new methods employed at the Saginaw Malleable Iron Division followed the talk.

Earl M. Strick spoke at an afternoon meeting of 400 boys from the Erie Technical High School, February 23. He talked on the foundry industry, and the old and new methods of cleaning castings. He praised the equipment manufacturers for their unceasing efforts in manufacturing modern equipment and the part they play in making the foundry a good place to work.

Central Michigan

C. C. Sigerfoos
Michigan State College
Chapter Vice-Chairman

THE CHAPTER OBSERVED National Officers and Top Management Night, February 10, at the Post Tavern Hotel, Battle Creek, Mich. National A.F.A. Vice-President W. B. Wallis was guest of honor. He gave a brief report of the activities of the Association as well as his observations of the English and French foundry industry.

Technical speaker was Lester B. Knight, Lester B. Knight & Associates, Chicago, who spoke on "Modernization of Small Foundries." He used many pictures to illustrate the proper steps to be taken in improving foundry methods. Mr. Knight illustrated the point that the first thing to do is to make a survey of existing equipment and production methods. He pointed out that no new production equipment should be considered until a careful check is made on all existing equipment to see if it is being used most efficiently.

In discussing production methods for molding, Mr. Knight said that the present trend is toward more match plate work because the plates give the foundry added control over many variables that occur when loose patterns are used. In adding new production equipment, Mr. Knight stressed the importance of selecting it on the basis of the castings being made and the flask and pattern equipment at hand. The speaker concluded by warning that new production equipment is no substitute for good management and that the situation usually found is that it requires better management and more thorough planning with the new methods.

Central Indiana

W. K. Mitchell
L. W. & W. K. Mitchell Co.
Chapter Reporter

AN ATTRACTIVE PROGRAM along with National Officers Night brought out 200 Hoosier foundrymen at the February 2 meeting of the chapter held in the Athenaeum, Indianapolis. Guests at the dinner

(Continued on Page 187)

Part of the head table at the Central Indiana chapter meeting of February 2 (starting left) F. E. Kurtz, Electric Steel Castings Co., Indianapolis; Rev. F. W. Hartsock; National A.F.A. Vice-President W. B. Wallis; Chapter Chairman Wm. Ziegelmueller, Electric Steel Castings Co., Indianapolis; A.F.A. Secretary-Treasurer Wm. W. Maloney, Chicago; and Chapter Vice-Chairman George Clark, Cummins Engine Co., Columbus, Ind.

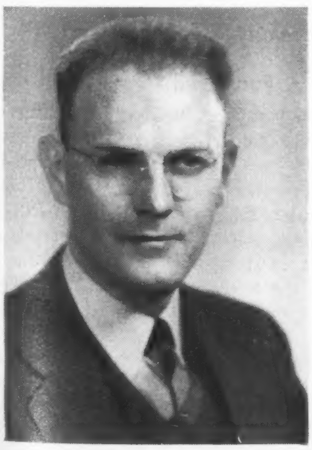
(Photo courtesy Henry Yeager, International Harvester Co.)

FOUNDRY *Personalities*

Hartley S. Ball has been appointed general manager, City Pattern Foundry & Machine Co., Detroit. Mr. Ball has long been associated with the pattern and foundry industry. His industrial experience started in 1927 when he was a journeyman patternmaker and layout man, covering both Detroit and Flint. He has held many important positions with Chevrolet and Buick and recently resigned as assistant superintendent in charge of all patterns and special foundry equipment, Buick Motor Car Company's iron foundry division.

William H. Kinkead has been appointed district sales manager for the state of Delaware, Link-Belt Co. His office will be located in Wilmington. He has been associated with the Philadelphia plant since 1920.

Leo A. Behrendt, formerly director, crucible and refractories division, Joseph Dixon Crucible Co., Jersey City, N.J., has been elected vice-president of marketing for the company's three industrial divisions—crucible and refractories, graphite and lubricants, and graphite paints. Mr. Behrendt is president, Crucible Manufacturers' Association.



J. A. Fellows

H. H. Judson, A.F.A. National Director, has been appointed foundry manager of the Lake Street Plant, Minneapolis-Moline Power Implement Co., Minneapolis, Minn. A graduate of Worcester Polytechnic Institute in 1923, Mr. Judson served as foundry engineer with the Riley Stoker Corp., Detroit, for many years, as foundry superintendent of Goulds Pumps, Inc., Seneca, N.Y., and for a time was with Standard Foundry Co., Worcester, Mass. Long prominent in A.F.A. affairs, Mr. Judson served on a number of Gray Iron Division committees prior to his election as a National Director in 1945.

John A. Fellows was recently made assistant chief metallurgist, American Brake Shoe Company's research center in Mahwah, N.J. He is resuming his association with American Brake Shoe after service in the atomic energy field and service with Union Carbon & Carbide Co. Dr. Fellows started with the company as assistant metallurgist in 1937.

Ernest V. Moncrieff, formerly president, Swan-Finch Oil Corp., New York, has been elected chairman of the board. **Howard F. Moncrieff,** formerly vice-president in charge of sales, was elected president and chief executive officer. Both have been with the company for over 30 years.

R. T. Leisk

James M. Barker of Chicago has been elected to the board of directors of Allis-Chalmers Mfg. Co., replacing A. J. Kieckhefer, who recently resigned. The appointments of W. A. Roberts and W. C. Johnson, executive vice presidents, to the executive committee of the board, were also announced.

Four major appointments have been announced by General Electric X-Ray Corp., Milwaukee. Those affected are: **R. L. Lefevre, W. D. Crelley, G. W. Happe** and **L. L. Ludwigsen.**

Mr. Lefevre, formerly manager, Washington, D.C., branch sales office, has become head, sales department. Mr. Crelley, who was manager, advertising and sales promotion department, is now head, merchandising department. Mr. Happe, affiliated with the company for 32 years and formerly assistant to the vice-president in charge of sales, has been named manager, products department. Mr. Ludwigsen heads the newly created services department. He was formerly manager, merchandise department.

Fred P. Biggs has been appointed first vice-president, Brake Shoe & Castings Div., American Brake Shoe Co. Mr. Biggs has been with Brake Shoe since 1916. He will continue as vice-president in charge of sales, Brake Shoe & Castings and Southern Wheel Divs., positions which he has held since 1944. He attended University of Washington.

Charles Locke

Charles Locke, formerly metallurgist, West Michigan Steel Foundry Co., Muskegon, Mich., and Vice-Chairman A.F.A. Steel Division, is director, foundry research, Armour Research Foundation, Chicago.

Roland T. Leisk, formerly assistant works manager, American Steel Foundries, at East St. Louis, Ill., has been appointed Manager of American's Indiana Harbor, Ind. plant, effective March 26. A past chairman and present director of the St. Louis District Chapter of A.F.A., Mr. Leisk replaces H. M. Rishel, retired.

Roger W. Batchelder has been appointed assistant to the president, National Bearing Div., American Brake Shoe Company and **William H. Old** has been made general purchasing agent for the same firm.

Mr. Batchelder, formerly general pur-

(Continued on Page 183)

NEW Foundry Products

Readers interested in obtaining additional information on items described in New Foundry Products should send requests to Reader Service, American Foundryman, 222 W. Adams St., Chicago 6, Ill. Refer to the items by means of the convenient code numbers.

High-Temp Concrete

AP1—A high strength, chrome-base refractory concrete, Kromecast, able to withstand temperatures as high as 3100 F, has been developed by the Babcock & Wilcox Co. Kromecast can be poured into place as easily as ordinary concrete or applied by plastering or with a cement gun, provides exceptional volume stability at temperatures up to 3100 F while providing protection against attack by fuel slags, metallurgical and chemical slags, and other reactive products. Kromecast can be installed in a fraction of the time necessary for plastics and can be used to construct walls and roof arches. A second new product, Hydrochrome, for use in furnaces wherein spalling conditions are not so severe, has a temperature limit of 2800 F.

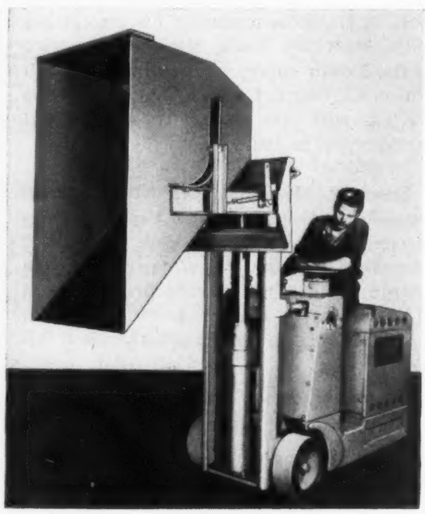
Power Sweeper

AP2—A high speed power sweeper, equipped with a 36 in. revolving brush and vacuum dust control, developed by the G. H. Tennant Co. enables one man to sweep as much as 44,000 sq ft of floor space per hour. The sweeper has a self-starter and drives like a car. It is powered by a 6 hp air-cooled gasoline engine. As brush revolves, litter and heavy dust are

thrown forward into a removable dirt hopper. At the same time, lighter dust is sucked from the top of the brush compartment into a fabric bag. Easily operated, the unit's forward motion is controlled by a single pedal, with another pedal serving as foot throttle. Removable brush can be raised or lowered by a lever. Large steering wheel permits 128° turns.

Self Dumping Hopper

AP3—A self-dumping hopper attachment designed to handle small castings, scrap metals and other bulk materials and applicable to all Lewis-Shepard gas or electric powered fork trucks, can be completely operated from the driver's position in the fork truck. In loading, the hopper is maneuvered under the discharge orifice



to receive materials. In discharging, the hopper is elevated. Without leaving position, the operator releases a holding latch and the hopper dumps the load, returning itself to an upright position. Steel-constructed the hopper is furnished in a range of cubic feet capacities depending upon fork truck capacity and type of materials to be handled. Hopper is easily replaceable with conventional forks by removal of a few bolts.

Safety Tongs

AP4—Lightweight and extremely strong, Hills-McCanna Co. new magnesium safety tongs can be made to any design, as cast or completely assembled. Advantages are: reduced operator fatigue, less damage to dies, reduced chances of injury. Tongs are 12 in. long and weigh only 6 ounces.

Pneumatic Hammer

AP5—A pneumatic hammer designed for precision work at top speed with minimum vibration is announced by Borm Manufacturing Co. The Elgin Model "G" Utility Hammer features compact, all-steel construction, greater striking power, combination locking type tool holder that eliminates danger of falling or flying tools, and trigger air control. Approximate speed: 5,000 strokes per minute at 100 lb air pressure. Net weight: 3½ lb.

Control Valve

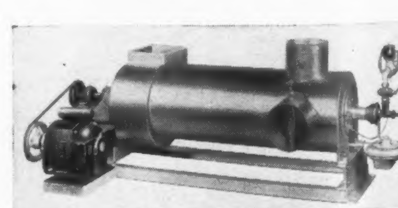
AP6—A three-way, neutral position hand operated valve, the 1291-N3, announced by C. B. Hunt & Son, Inc., features a forged bronze handle, brass sleeve, stainless steel body and adapter, and a forged bronze head fitted with a flat spring that indexes and holds the handle in "on," "off," "hold" and "neutral" positions. Designed for use with single acting air cylinders and hoists. Furnished in ⅜ and ½ in. pipe sizes for air pressures up to 250 psi.

CO_2 Indicator Kit

AP7—An indicator that tells the carbon dioxide content of stack gas in less than one minute is announced by Burrell Technical Supply Co. Consisting of a transparent plastic barrel with aluminum end caps, a stainless steel tube containing a dry CO_2 absorbing cartridge, and a metal gravity piston, the Burrell Indicator has an accurate gauge calibrated to read directly in per cent CO_2. Gas sample is drawn from the stack and pumped into the barrel and, as the CO_2 is absorbed, the gauge indicates the percentage of CO_2. Combustion indicator determines percentage heat loss and excess air for bituminous coal, coke, natural gas and fuel oil.

Packaged Heat Unit

AP8—A midget utility air heater with improved design features, available as a complete package unit, is announced by Gas Appliance Service Inc. In addition to the heater, the package includes fan, motor, drive, safety devices and temperature control. Direct fired for maximum efficiency, the midget heater can be employed for heating drying rooms and small indus-



trial ovens. With a heating capacity of 125,000 btu per hour, the heater is suitable for temperatures up to 350 F. Fan capacity is 1000 cfm. Temperature controls of either indicating or non-indicating type are furnished as desired. Safety devices are designed to shut off gas supply in case of flame, fan or power failure.

PERSONALITIES

(Continued from Page 179)

chasing agent, has been with Brake Shoe since 1933. In his new position he will be located at the division headquarters in St. Louis.

Mr. Old, formerly assistant general purchasing agent, joined the company in 1940. He will continue to be located in New York.

Ben H. Sachs, Jr., has joined Helburn Engineering, Cincinnati, manufacturers agents. Formerly with American Air Filter Co., Inc., Louisville, Ky., he will handle air filters, dust control equipment, engines and compressors. Prior to joining American Air Filter in 1946, Mr. Sachs served three years in the Navy. He was graduated from the University of Louisville.

Crawford H. Greenwalt recently became president, E. I. du Pont de Nemours & Co., Wilmington, Del., while **Walter S. Carpenter, Jr.,** was elected chairman of the board. Mr. Carpenter's resignation as president, and his election as chairman of the board, followed the retirement of Lammot du Pont from the latter post. Mr. du Pont's action ends a career in the company that began in 1902.

Robert Fisher, The Falk Corp., Milwaukee, and Chairman, A.F.A. Job Evaluation & Time Study Committee, has been placed in charge of all standards throughout the Falk plant.

J. Robert Pauline has been appointed works manager, Kellogg Division, American Brake Shoe Co., Rochester, N.Y. Mr. Pauline, formerly assistant to the vice-president in charge of operations and engineering, has served in various supervisory capacities since 1943 when he first joined Brake Shoe as an engineer.

John P. Stevens, Jr., president, J. P. Stevens & Co., Inc., since 1942, was elected a director, American Brake Shoe Co., New York.

Glenn W. Merrefield, formerly associated with Lester B. Knight & Associates, Chicago, has been appointed Michigan representative for the Champion Foundry & Machine Co., Chicago.

Lester Samstag and **Robert E. Keith** have been appointed production metallurgist and metallurgical sales engineer, respectively, for the General Aluminum Mfg. Co., Cleveland.

On graduation from Ohio State University, Mr. Samstag went with Aluminum Co. of America, Cleveland, as metallurgical production engineer, permanent mold department. After five years with Aluminum Co. he accepted a position with Maco Corp., Huntington, Ind., as metallurgical production engineer.

Mr. Keith studied at Missouri School of Mines and Colorado School of Mines. He entered the service and upon being dis-

charged was appointed assistant plant metallurgist, Aluminum Co. of America, Cleveland. After two and a half years he accepted a position as production metallurgist, Thompson Products aluminum foundry where he remained over a year.

General Donald Armstrong, former commandant, Industrial College of the Armed Forces, has been made executive vice-president, U. S. Pipe & Foundry Co., Burlington, N.J.

Donald H. Workman has been named promotion manager, Gray Iron Founders' Society, Inc., Cleveland.

J. D. Wilson, Jr., and **Milton Glazer** have been added to the sales staff of James Flett Organization, Chicago. Mr. Wilson has been assigned to the Cleveland area and Mr. Glazer to the northern Indiana district.

Louis X. Ely has assumed the position of consultant, Rockwell Mfg. Co., Monessen Foundry Div., Monessen, Pa. Mr. Ely was owner, Monessen Foundry & Machine Co. which was organized in 1905. When his foundry became a division of Rockwell Mfg. Co. in August, 1945, he consented to remain as general manager. He has served in that capacity until the present.

C. H. Daugherty, formerly Mr. Ely's assistant, will assume the duties of general manager.

Arthur A. Clay, controller of the Ohio Steel Foundry Co., Lima, O., has announced his resignation effective March 1 to go in business for himself as foundry consultant, specializing in cost systems, production control and similar management problems. He has written for *American Foundryman* (August, 1947) and other publications, and has spoken at a number of foundrymen's meetings. A certified public accountant and an instructor in accounting practices at Ohio Northern University, Mr. Clay has been engaged in fiscal and management work for more than 25 years.

George F. Burditt has been appointed sales engineer, American Wheelabrator & Equipment Corp., with headquarters in Pittsburgh, Pa. A graduate of Kansas State College, he was formerly with Gustin Bacon Co. and the U. S. Soil Conservation Service.

Don Elton Richards, principal consultant for industrial relations, C. T. Gilliam & Associates, Los Angeles, and a member of the A.F.A. Apprentice Training Committee, has accepted a position as supervisor of vocational education of Arabia. Mr. Richard's address is: Arabian-American Oil Co., Daharan, Arabia.

Arthur J. Wieland, a director of the Wilson Foundry and Machine Co., Pontiac, Mich., has been elected vice-chairman of the board of directors, according to a recent announcement. Mr. Wieland was also named executive vice president of Willys-Overland Motors, parent company of Wilson Foundry and Machine.

Le Roy E. Taylor, formerly engineer of tests, Illinois Clay Products Co., Chicago, is now affiliated with Covel Mfg. Co., Inc., Benton Harbor, Mich.

Obituaries

Leslie A. Wiggins, vice-president in charge of the Rome division, Revere Copper & Brass Inc., Rome, N.Y., died March 5 of a heart ailment. He was 55 years old. He headed Revere's largest mill products division and had started with the firm in 1919. In 1926 he was made sales manager and 10 years later was elected vice-president.

Ernest Baldwin, 63, president and owner of the Spalding Foundry Co., Atlanta, Ga., died March 23 at his home in Atlanta. A native of Nashville, Tenn., Mr. Baldwin first became associated with the foundry industry in that city in 1908. In 1939, he joined the Spalding Foundry Company, which he purchased two years later.

Thomas Moses, 78, retired president of the U. S. Coal & Coke Co., the H. C. Frick Coke Co., and other subsidiaries of the United States Steel Corp., died February 20 in Danville, Ill. Welshborn, Mr. Moses, became a coal mine employee in Indiana at the age of 11, and a full-fledged miner at 14. He later served as secretary of the Illinois State Mining Board and as State Mine Inspector. In 1915, Mr. Moses became general superintendent of the Westville, Ill., branch of the United States Fuel Company, and in 1927, was elected president of the coal producing subsidiaries of the U. S. Steel Corp. He became vice president of raw materials of the United States Steel Corp. of Delaware in 1938, retiring a year later. After retirement, Mr. Moses served as Director of Mines and Minerals for the State of Illinois until the time of his death.

Thomas W. McCausland, 76, president of the Hyde Park Foundry & Machine Co., Hyde Park, Pa., until his retirement in January this year, died recently at his home in Pasadena, Calif.

R. J. Murray II, secretary-treasurer of the Jessop Steel Co., Washington, Pa., died February 23. An employee of Jessop since 1925, Mr. Murray served as purchasing agent for several years prior to his appointment as secretary-treasurer in 1936.

William A. Bohne, 52, assistant director of plants, E. F. Houghton & Co., Philadelphia, died late in February after a long illness at his Jenkintown, Pa., home.

Harold D. Boyd, assistant superintendent of the Medina Iron & Brass Co., Medina, N.Y., died recently as the result of an accident. He had been associated with the Medina foundry since October, 1947.

F. L. Overstreet, foundry engineer, Illinois Clay Products Co., Chicago, died December 23. Mr. Overstreet was particularly active in the work of the Committee on Analysis of Casting Defects and its publication ANALYSIS OF CASTING DEFECTS.

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included A.F.A. Vice-President W. B. Wallis, and A.F.A. Secretary-Treasurer Wm. W. Maloney, Chicago, and Frank C. Steinebach, Penton Publishing Co., Cleveland.

Mr. Wallis described economic conditions in England and western Europe, basing his remarks on his recent travels in this territory. Mr. Maloney commented on the activities of the Association and the progress made by the Educational Division in its college training program and other educational work.

The group then was divided into two sections—ferrous and non-ferrous, F. J. Wurscher, Chicago Railway Equipment Co., Chicago, addressed the ferrous men on "Duplexing and Triplexing Melting Operations." The non-ferrous men heard an informative lecture on "Non-Ferrous Melting Atmospheres" by H. L. Smith, Federated Metals Div., American Smelting & Refining Co., Pittsburgh.

Quad City

C. R. Marthens
Marthens Co.
Secretary-Treasurer

MEETING AT THE Fort Armstrong Hotel, Rock Island, Ill., February 16, the chapter heard L. P. Robinson, Werner G. Smith Co., Cleveland, discuss "Core Room Practice." The topic attracted 150 members and guests.

Mr. Robinson pointed out that close control of measurement of core ingredients gives best results. The discussion period following the talk gave many local foundrymen an opportunity to talk about their problems.

R. H. Swartz, Riverside Foundry, S. & W. Corp., Bettendorf, Iowa, chapter chairman, presided.

New England

Merton A. Hosmer
Hunt-Spiller Mfg. Co.
Association Reporter

THE GUEST SPEAKER at the February 11 meeting of the New England Foundrymen's Association was Joseph B. Stazinski, General Electric Co., Lynn, Mass. Mr. Stazinski spoke on foundry practices including suggestions for cupola operations and proper sand mixtures for various types of castings. He showed

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(*Continued from Page 187*)

a number of illustrations of the complete production of a mold, the pouring, and the cleaning of the casting. Over one hundred members and guests attended.

No. Illinois-So. Wisconsin

Carl Dahlquist
Greenlee Bros. & Co.
Technical Secretary

AN INFORMAL DINNER PARTY which was part of the Ladies' Night activity of the Northern Illinois-Southern Wisconsin chapter, was held February 10 at the Hotel Faust, Rockford, Ill. Following the dinner Prof. E. A. McFaul, Northwestern University, Evanston, Ill., addressed the group. His subject was "How is Your Sense of Humor?" He gave a humorous dissertation that everyone enjoyed.

New England Foundrymen's Ass'n.

M. A. Hosmer, Metallurgist
Reporter

CUPOLA OPERATION and the results of a questionnaire covering its factors were the subjects of the March 10 meeting, held at the Engineers' Club, Boston.

Walter M. Saunders, who presided, explained the results of the questionnaire, which covered preparation of the cupola, lighting up, charging, tapping, mixtures, and fluxes for cupolas from 24 in. to 72 in. in diameter.

The following members submitted questionnaires: T. G. Healey, Seaboard Foundry, Providence, R.I.; Albert Nutter, E. L. LeBaron Foundry Co., Brockton, Mass.; Robert C. Walker, Whitin Machine Works, Whitinsville, Mass.; Stanley Sowens, Riverview Foundry Co., Fall River, Mass.; Robert Wentrup, Grinnell Corp., Auburn, R.I.; Jack Bryniarski, Independent Lock Co., Fitchburg, Mass.; William Ohlson, Draper Corp., Hopedale, Mass.

Michiana Chapter

S. F. Krzezewski
American Wheelabrator & Equip. Co.
Chapter Reporter

H. M. ST. JOHN, superintendent of brass foundries, Crane Co., Chicago, was the guest speaker at the March 2 meeting, held at the Elkhart hotel, Elkhart, Ind.

In his address, "Quality Control in the Non-Ferrous Foundry," Mr. St. John urged that a systematic

(*Continued on Page 192*)

WHEELABRATOR TUMBLAST

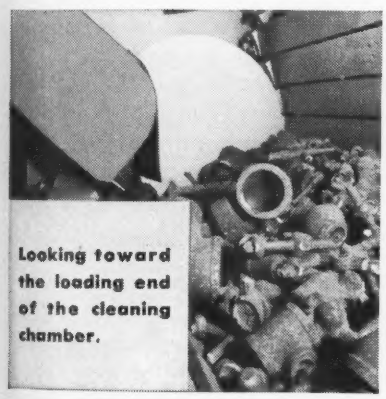
Your *High Production* Cleaning Problems

American pioneered the first Continuous blast mill and later exhibited it at the 1940 Foundry Show. Since that time the sound engineering design and performance of this machine have been proved to the satisfaction of users in some of the nation's largest industries.

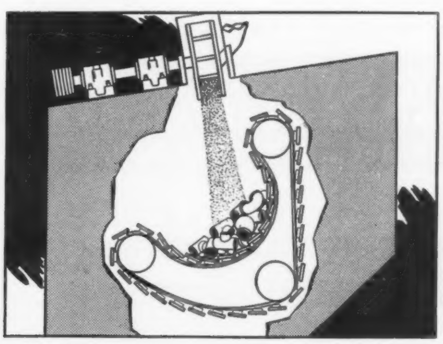
The machine illustrated will be shown in operation at the coming Foundry Show . . . it is the up-to-the-minute result of many years of engineering work on this type of equipment.

By utilizing the unique combination of tumbling and longitudinal travel of the work, plus the cleaning speed and cost-reducing advantages of the world-famed Airless Wheelabrator, this machine surpasses in productive capacity any barrel type blast equipment ever before offered.

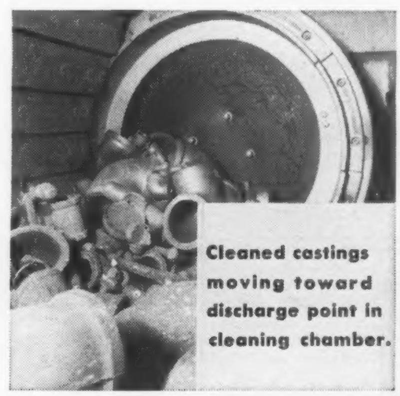
To see the continuous mill operate . . . to see the smooth flow of cleaned castings being discharged in a continuous stream . . . is to realize the full import of this machine in slashing costs and increasing production. See it operate at the Foundry Show in Philadelphia, May 3-7. In the meantime write for descriptive Bulletin No. 514.



Looking toward the loading end of the cleaning chamber.



Endless apron conveyor provides complete exposure of work to the blast.



Cleaned castings moving toward discharge point in cleaning chamber.

VISIT AMERICAN'S EXHIBIT AT THE FOUNDRY SHOW

See the Continuous Wheelabrator Tumblast, the new model 36" x 42" Wheelabrator Tumblast, and other outstanding AMERICAN equipment in operation.

THE AMERICAN MOLDER

American

WHEELABRATOR & EQUIPMENT CORP.

(FORMERLY AMERICAN FOUNDRY EQUIPMENT CO.)

630 S. Byrkit St., Mishawaka, Indiana

WORLD'S LARGEST BUILDERS OF AIRLESS BLAST EQUIPMENT

CHAPTER ACTIVITIES

(Continued from Page 189)

check be made covering inspection of cores, rough testing, and of the appearance of castings. Test bar specifications, he said, should not be overlooked and uniformity in dimension for production machining is most essential.

In analyzing jobbing foundry problems, Mr. St. John outlined difficulties encountered through short runs, and irregularities of castings. He stated that the principal causes of defective castings are faulty pattern equipment, faulty molding and improper sand and cores.

To avoid repetition of difficulties, Mr. St. John recommended the use of a card index for each part, listing the defects, temperature of metal and general casting conditions.

Chapter Chairman Howard Voorhees, works manager, Peru Foundry Co., Peru, Ind., presided over the meeting, which also featured a program by the Doctors of Harmony, nationally-known quartet. Frank McGuire, metallurgist, Sibley Machine & Foundry Corp., South Bend, Ind., program committee chairman, introduced the speaker.

Central Ohio

H. W. Lownie, Jr.
Battelle Memorial Institute
Chapter Reporter

MALLEABLE IRON FOUNDING was discussed at the February 23 meeting by James H. Lansing, consulting engineer, Malleable Founders' Society, Cleveland. Mr. Lansing traced the history of the malleable iron industry from the days of Reamur and Boyden until the present. He covered development of the manufacturing process, annealing, cleaning, grinding, and straightening. A number of samples of malleable iron were exhibited to demonstrate the malleability of the product. The results of an extensive survey on the effects of the carbon content of malleable irons showed that irons with about 2.20 per cent carbon generally produce higher elongations than irons containing about 2.60 per cent carbon. Illustrations of unique systems of gating used for special purposes within the industry were of considerable interest.

Concurrently, the steel section of

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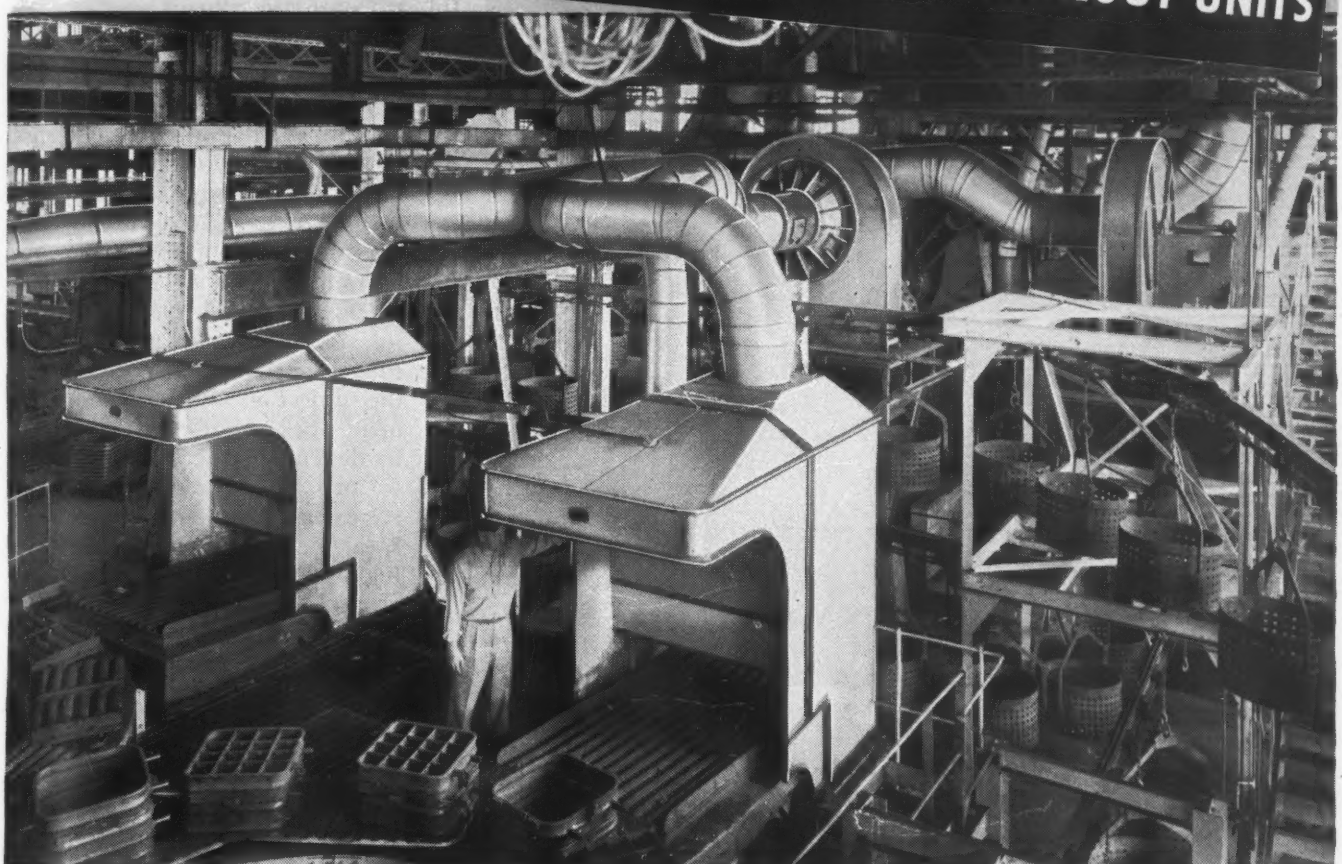

CHAPTER ACTIVITIES

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the chapter was addressed by L. C. Tate, Ford Motor Co., Detroit, on the subject of "Measurement of Temperatures of Molten Metal." A large part of the material presented by Mr. Tate has been published in TRANSACTIONS of A.F.A., volume 55, 1947. Radiation pyrometers were discussed and a method of using these instruments in conjunction with immersion tubes was explained. The platinum platinum-rhodium thermocouple protected with a silica sheath, and a refractory block to protect against slag attack, was also described. Immersion temperatures of the order of 2600 F can be measured with such a thermocouple if adequate attention is given to its design. The development of the tungsten-graphite thermocouple for immersion in metals up to about 2650 F was also described. Suitable for use as an immersion thermocouple for steel, this couple has been the subject of considerable development work at Ford and has paid off by dependable performance.

Corp. K. K. Elder, Ohio State Highway Patrol, was the coffee speaker. He presented an interesting and instructive talk on highway safety and pointed out the numerous dangers of high-speed driving, inattention and inadequate maintenance of vehicles.

Chesapeake

J. H. Schaum
Naval Research Laboratory
Chapter Reporter

FOUNDRYMEN OF THE CHESAPEAKE chapter heard guest speaker Donald Potter, Stewart-Warner Corp., Chicago, present an informative talk in which he described completely the many intricate operations required to produce precision castings by the lost-wax and the plaster mold processes. The talk was well illustrated with slides and included many procedures developed at the Naval Research Laboratory where Mr. Potter formerly directed precision casting studies. The meeting was held February 27 at the Engineers Club, Baltimore, Md.

At the January meeting, Capt. Schade, director, Naval Research Laboratory, gave an informal coffee talk about some of his experiences guiding the Naval Technical Mission in Europe. The meeting then

broke up into three groups for round table discussions.

At the cast iron meeting, B. A. Miller, Baldwin Locomotive Works, Philadelphia, discussed problems of cupola operation. Certain practices were recommended for increasing the carbon and reducing the silicon pick-up.

A. H. Hesse, R. Lavin & Sons, Chicago, conducted the non-ferrous round table where it was emphasized that H_2, H_2O and CH_4 gases in metals can be controlled through creation of neutral, reducing and/or oxidizing furnace atmospheres.

A description of equipment and operation of electric arc furnaces of 6 and 25 ton capacity in the manufacture of carbon and alloy steel castings and ingots at the Washington Navy Yard foundry was given by E. C. Crown, Naval Gun Factory, Washington, D.C.

Instead of the usual technical meeting during December, the chapter scheduled a gala oyster party. The attendance—in the neighborhood of 350—broke all records for a Chesapeake chapter meeting.

Metropolitan
W. H. Ferguson
Electro Metallurgical Sales Corp.
Chapter Reporter

A LARGE GROUP of local foundrymen turned out for the February meeting and joined in the round table discussions. The four discussion groups were: gray iron, steel, aluminum-magnesium, and copper-base alloys.

A. E. Winstead, Moore Bros. Co., Elizabeth, N.J., led the discussion of gray iron problems. Coke was discussed at length from the standpoint of quality of present day coke, increased amounts required to melt iron today, sulphur pickup, and carbon pickup. Gating, risering, and casting defects were presented with members of the group citing specific defects which were causing their trouble.

The discussion leader for steel was H. E. Cragin, Taylor-Wharton Iron & Steel Co., High Bridge, N.J. Mr. Cragin brought up an interesting problem regarding the change in dimensions of a mold from the time it is made until it is poured. Various possible causes of dimensional change were suggested. Heading, gating, and risering were touched upon. Other subjects cov-

ered involved tapered slip flasks, ladle life, porosity in high alloy steels, and sand reclamation.

Aluminum and magnesium problems were presented under the leadership of Anthony Cristello, Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N.J. This group also discussed heading, gating and risering. Other phases of the casting of these alloys covered were melting practice, fluxes, natural and synthetic sands, surface pitting of aluminum castings, oxide in magnesium castings poured in plaster molds, and the use of perforated steel screens for aluminum and magnesium alloys.

J. A. Bukowski, Worthington Pump & Machinery Corp., Bloomfield, N.J., led the meeting on copper-base alloys. Various items covered were melting technique, gases such as H_2S and CO in castings, and the role of the test bar in the production of castings. Specific problems involving aluminum bronzes and manganese bronzes were outlined.

British Columbia

Norman Terry
Canadian Sumner Iron Works Ltd.
Chapter Chairman

In its first season, the British Columbia chapter has been extremely busy. Activities began last October when A.F.A. National President Max Kuniansky, visited Vancouver. Since then, meetings have been held on the third Tuesday of each month at the Medical Dental Auditorium where speakers address the membership on technical subjects.

The first chapter project was to conduct a six-week educational course on foundry fundamentals at the Vancouver Technical School with the co-operation of the Vancouver City Night Schools. The response was most encouraging. Nearly fifty applied and are "going back to school" to learn the modern and scientific methods of foundry practice. The lectures cover casting design, cupola practice, sand control and testing, molding, coremaking and other related subjects. This first venture having proved so successful, more extensive plans are being formulated for the future. Prof. Wm. M. Armstrong, mining and metallurgy department, University of British Columbia, Van-

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CHAPTER ACTIVITIES

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couver, and a director of the chapter, is chairman of the chapter educational committee.

Another important chapter project is the local apprentice contest. Four groups of apprentices are competing—iron molding, steel molding, non-ferrous molding and patternmaking. Over thirty foundry apprentices from Victoria, New Westminster, and Vancouver are competing in this contest. The work of the contestants is being examined and judged by a committee of local foundrymen and prizes will be awarded to the local winners. The winning castings and patterns will be sent on as the British Columbia entry in the national A.F.A. Apprentice Contest. The keen interest of both apprentices and employers in this contest certainly justifies the work entailed in its planning and preparation. The committee handling the project is headed by J. A. Dickson who is ably assisted by W. Catherall, both of Vancouver Technical School.

Michiana

S. F. Krzeszewski
American Wheelabrator & Equip. Corp.
Publicity Chairman

COVERING THE IMPORTANT SUBJECT "Dielectric Heating for Core Baking," J. W. Goring, sales engineer, Arthur B. Sonneborn Co., Grand Rapids, Mich., revealed his experiences in research covering a period of eight months. These involved various processes of core sand preparation, the use and reactions of various oils, the use of sea-coal, baking temperatures, and moisture content.

Mr. Goring stated that dielectric baking is most applicable to long runs of similar sized cores. He also showed the savings that will be derived if coremaking is synchronized with molding and pouring. For job foundries, where a large variety of cores are made, dielectric baking is not practical, he said.

During the afternoon, approximately 65 members of the chapter accepted the invitation extended by the Oliver Corp., South Bend, Ind., through Martin J. Lefler, plant manager, and visited its foundry. The foundry was recently completely mechanized and is classed as one of the largest and most modern foundries in the country.

Detroit

C. J. Rittinger
American Car & Foundry Co.
Publicity Chairman

THE REGULAR MONTHLY MEETING of the chapter was held February 19 at the Horace H. Rackham Memorial building. The dinner and group sessions were well attended. Prior to the sectional meetings, Walter W. Fuller, *Detroit News,* gave a coffee talk, "I'm Telling You."

Speaking before the gray iron group, V. A. Crosby, metallurgical engineer, Climax Molybdenum Co., Detroit, talked on the "Selection of Gray Iron for Automotive Use." He surveyed existing specifications, and indicated in which directions improvements may be affected. The discussion leader was J. E. Coon, metallurgist, Packard Motor Co., Detroit.

Chapter Vice-Chairman, Northeastern Ohio chapter, E. C. Zirzow, National Malleable & Steel Castings Co., Cleveland, was the principal speaker at the malleable session. Topic for this group was "Malleable Foundry Practice." During the course of his talk he emphasized recent developments in malleable foundry practice, including the use of chemically bonded sand. Acting as discussion leader was H. Gravlin, Ford Motor Co., Detroit.

"Brass and Bronze Melting" was the subject discussed before the brass and bronze men. The topic was ably handled by H. L. Smith, Federated Metals Div., American Smelting & Refining Co., Pittsburgh, Pa. He explained how melting plays a great part in deciding the external appearance of castings, their soundness, and particularly their mechanical properties. Success in the production of bronze castings depends entirely upon the metallurgical control of composition, melting conditions and casting temperature, he said. Leading the discussion was Vaughan C. Reid, City Pattern Foundry & Machine Co., Detroit.

Metropolitan Chapter

W. H. Ferguson
Electro Metallurgical Sales Corp.
Chapter Recorder

APPROXIMATELY 200 MEMBERS attended the March 1 meeting of the Metropolitan chapter. Designated as "National Officers' Night," the session was attended by National

President Max Kuniansky; National Directors H. A. Deane, American Brake Shoe Co., New York; John M. Robb, Jr., Hickman, Williams & Co., Philadelphia; H. G. Lamker, Wright Aeronautical Corp., Wood Ridge, N.J.; and A.F.A. Secretary-Treasurer William W. Maloney, Chicago.

President Kuniansky opened the meeting with an address on the foundry industry's advancements in technology and practical experience during the last quarter-century.

Stressing the importance of A.F.A. meetings in keeping workers informed on new methods and developments President Kuniansky stated, "No industrial enterprise needs modernization as much as the average foundry plant, and through A.F.A. the impetus for modernization has increased tremendously during recent years."

National Secretary Maloney spoke briefly on current activities of the Association, and invited the audience to attend the 52nd Annual Meeting, to be held in Philadelphia May 3-7.

Thomas Curry, Lynchburg Foundry Co., Lynchburg, Va., delivered the technical address of the evening, "Chemically Treated Sands," illustrated with slides showing grain distribution of sands and examples of castings made by this method.

Mr. Curry cited the fact that proper utilization of chemically-treated sands, while requiring a good deal of control work, nevertheless requires only one-fourth as much binder as is needed for synthetic sands. Additional advantages are the high mold hardnesses and mold strengths developed, resulting in reduced cleaning costs.

Northwestern Pennsylvania

Earl M. Strick
Erie Malleable Iron Co.
Chapter Reporter

As ITS PRINCIPAL SPEAKER for January 26, the chapter had G. P. Halliwell, H. Kramer & Co., Chicago. The meeting was held in the Moose Club, Erie.

Mr. Halliwell covered the nonferrous metal industry in a most concise manner and the question and answer period was one of the most active of the year.

FIRM FACTS

The **E. R. Frost Co.,** Mineapolis, which represents the Tabor Mfg. Co., Philadelphia, is having its territory increased by northwestern Wisconsin bounded on the south and east by a line running from LaCrosse to Chippewa Falls and from there to Hurley, and that portion of Iowa north of a line running east and west through Galena, Ill., Rockwell City, Iowa and just south of Sargeant on the western boundary of Iowa.

The **M. W. Warren Coke Co.,** St Louis, is having its territory increased by the state of Nebraska and that part of Iowa south of the line through Galena.

Chico Iron Foundry, Chico, Calif., a newly established company, is pouring gears and parts for the Diamond Match Co.

Regional sales offices have been opened in Cincinnati and St. Louis by the **James Flett Organization,** Chicago. Hedley Thomas will head the Cincinnati office, located in the Union Trust Building, and Roger K. Taylor, in St. Louis, will be in the Chemical Building.

Industrial Air Products Co., 3200 N.W. Yeon Ave., Portland 10, Oregon, has been made a distributor of welding machines and electrodes for the Wilson Welder & Metals Co., New York.

The **Union Mfg. Co.,** New Britain, Conn., has acquired the Hannifin Corp., Chicago.

Kaiser-Frazer Corp. announced recently the purchase of a blast furnace and coke ovens in Utah from the War Assets Administration for $1,150,000. The plants have a capacity of 300,000 tons of pig iron a year. The blast furnace is located at Ironton, near Provo, Utah. The purchase includes 500 bee hive coke ovens near the Price, Utah, coal fields, with a capacity of 750 tons a day.

Baker-Raulang Company's Baker Industrial Truck Division announces the appointment of the Hooper-Green Company, 1039 N. Pennsylvania St., Indianapolis, as district sales representatives in Indiana.

Charles A. Krause Milling Co. announces the removal of its executive and general offices to 404 E. State St., Milwaukee. All future business will be transacted from the new address.

Black, Sivalls & Bryson, Inc., announces the reorganization and expansion of its foundry equipment department. C. W. Boettcher will be in charge of special equipment quotations and expediting production. C. C. Zircher will be in charge of order processing and sales statistics.

A fire starting in the welding room of the **American Boiler & Foundry Co.,** Milan, Mich., February 3, destroyed the shipping and warehouse departments.

FOUNDRY LITERATURE

Readers interested in obtaining additional information on items described in Foundry Literature should send requests to Reader Service, American Foundryman, 222 W. Adams St., Chicago 6, Ill. Refer to the items by means of the convenient code numbers.

AP100—A colorful, illustrated wall chart listing do's and don't's for the handling and melting of aluminum in foundries is offered by Federated Metals Div., American Smelting & Refining Co.

AP101—Describing and illustrating Newaygo Engineering Co.'s line of foundry equipment, recently-released Bulletin 204 shows sand handling systems, mold conveyors, turntables, rotary plate feeders, sand gates, conveyor belt take-ups, sand coolers and aerators, core crushers, sand conditioning mills, core drawing machines and floor line markers. Included are several foundry layouts and installation views.

AP102—An illustrated, four-page folder listing the current line of MGC products is announced by Motor Generator Corp. Described are: metal plating equipment, buffers and grinders, electro power units and materials handling equipment.

AP103—"Precision Tumbling With Alundum Abrasive," an 18-page illustrated brochure recently released by the Norton Co., outlines the specifications, uses and application of Alundum abrasives.

AP104—"Cerro Alloy Casting Procedure," the first of a series of single sheets describing the applications of low-temperature-melting alloys, is announced by the Cerro de Pasco Copper Corp. Sheets are provided in looseleaf form for permanent record.

AP105—"Safety is a matter of using your head to save your skin," according to Allegheny Ludlum Steel Corp.'s new 20-page booklet, "Safety," which provides a brief, highly-readable resume of the "do's" and "don'ts" of plant operations as they apply to employees. Precautions against fire, molten metals, heat, falls, gases and similar plant hazards are outlined, and effective first aid measures are shown.

AP106—The first nationally accepted provisions for the construction and operation of mechanical conveyors and equipment, the "American Standard Safety Code for Conveyors, Cableways and Related Equipment (B20.1-1947) is announced by the American Standards Association. The experience of a wide variety of national groups in the field was called upon in preparation of these recommendations, which include special provisions for safe operation of each type of conveyor, and recommended safety guards and devices. Price: 90 cents.

AP107—"Brief Notes for the Busy Foundryman" is a comprehensive collection of technical papers and brochures on foundry sand practices, recently made available in handy briefcase form by the American Colloid Co. Included are a 32-page booklet, "The Sperser Method for Rebonding Foundry Sands" and a 78-page brochure, "Foundry Sand Practices" (revised edition). Also included are reprints of several technical papers plus Newsletters one through 21, and brochures.

AP108—B. F. Gump Co. is distributing gratis a catalog which describes and illustrates rotary sifters.

AP109—A ten-page reprint, "Machining Cast Aluminum Alloys," has just been issued by the Apex Smelting Co. Beginning with a discussion of the overall problems of machining cast aluminum alloys, the booklet further discusses tool shapes and materials, cutting compounds, cutting speeds, lathe practice, milling, shaping and planing. A selected bibliography of texts on the subject is also included.

FOUNDRY FILMS

AP110—Use of oxygen and other modern techniques of electric furnace production of stainless steel is brought to the screen in full color in Allegheny Ludlum's 16mm film, "Melting and refining of Modern Steels." Filmed at Allegheny's Breckenridge (Pa.), plant, the motion picture depicts a start-to-finish story of the melting of stainless steel in a 50-ton electric furnace. Featured for the first time on film is the process of injecting oxygen directly into the molten metal for carbon reduction. Telephoto lenses used for interior shots create the effect of the camera being actually inside the furnace. Available on loan free of charge.

AP111—"Strange Interview," a 55-minute sound motion picture produced by Jam Handy for General Motors Corp.,

utilizes a reincarnated Benjamin Franklin to illustrate how foundry and shop employee relations can be bettered by the application of human understanding. General Motors announces that the film will be loaned without charge to any interested group in the metals and foundry fields.

• THE BUYERS' GUIDE •

As a service to A.F.A. Members and those who use Association media for promoting the usefulness of their products in the Foundry Industry, current AMERICAN FOUNDRYMAN Advertisers and Exhibitors at the 1948 Foundry Show are presented in the Official Convention Issues Buyers' Guide.

Advertisers indicated by asterisk (*).

ABRASIVES (Blasting)

*Alloy Metal Abrasive Co., 311 W. Huron St., Ann Arbor, Mich.
American Steel Abrasives Co., Sherman & East Sts., Galion, Ohio.
*Carpenter Brothers, Inc., 606 W. Wisconsin Ave., Milwaukee 3.
*Cleveland Metal Abrasive Co., 887 E. 67th St., Cleveland.
Globe Steel Abrasive Co., 238 First Ave., Mansfield, Ohio.
Harrison Abrasive Corp., P.O. Box 290, Elizabeth, N.J.
*Ottawa Silica Co., Box 437, Ottawa, Ill.
*Pangborn Corp., Hagerstown, Md.
*Pennsylvania Foundry Supply & Sand Co., Ashland & E. Lewis Sts., Philadelphia 24.
George Pfaff, Inc., 10-61 Jackson Ave., Long Island City 1, N.Y.
*Pittsburgh Crushed Steel Co., 4839 Harrison St., Pittsburgh 1.

ABRASIVES (Grinding)

*Bay State Abrasive Products Co., Union St., Westboro, Mass.
DoAll Co., 254 N. Laurel Ave., Des Plaines Ill.
*Manhattan Rubber Div., Raybestos-Manhattan, Inc., 61 Willett St., Passaic, N.J.
*Peninsular Grinding Wheel Co., 729 Meldrum Ave., Detroit 7.
George Pfaff, Inc., 10-61 Jackson Ave., Long Island City 1, N.Y.
*Simonds Abrasive Co., Tacony & Fraley Sts., Philadelphia 37.
*Sterling Grinding Wheel Div., Cleveland Quarries Co., Tiffin 3, Ohio.
Tabor Mfg. Co., 6225 Tacony St., Philadelphia 35.

ACETYLENE

Air Reduction Sales Co., 42nd St., opposite Grand Central, New York 17.
Linde Air Products Co., 30 E. 42nd St., New York 17.

AERATORS

*Jeffrey Mfg. Co., 977 N. 4th St., Columbus 16.
Newaygo Engineering Co., Newaygo, Mich.
Standard Sand & Machine Co., 549 W. Washington Blvd., Chicago 6.

AFTER-COOLERS

*Ingersoll-Rand Co., 11 Broadway, New York 4.
*Jas. A. Murphy & Co., 5th & Vine Sts., Hamilton, Ohio.
*Nichols Engineering & Research Corp., 60 Wall Tower, New York.

AIR COMPRESSORS

Allis-Chalmers Mfg. Co., 1126 S. 70th St., Milwaukee 1.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York 17.
Davey Compressor Co., Maple & Walnut Sts., Kent, Ohio.
*Ingersoll-Rand Co., 11 Broadway, New York 4.
*Schramm, Inc., West Chester, Pa.
*U.S. Hoffman Machinery Corp., 99 Fourth Ave., New York 3.

AIR LINE ACCESSORIES

Dallett Co., Mascher at Lippincott St., Philadelphia 33.
*Jas. A. Murphy & Co., 5th & Vine Sts., Hamilton, Ohio.
A. Schraders Son, Div. of Scovill Mfg. Co., Inc., 470 Vanderbilt Ave., Brooklyn 17, N.Y.

AIR PURIFIERS

*American Air Filter Co., Inc., 215 Central Ave., Louisville.

AIR SEPARATORS

*Jas A. Murphy & Co., 5th & Vine Sts., Hamilton, Ohio.

ALLOYS (Aluminum & Magnesium)

*Apex Smelting Co., 2537 W. Taylor St., Chicago 12; 6700 Grand Ave., Cleveland 5.

ALLOYS (Ferrous)

*Electro Metallurgical Co., 30 E. 42nd St., New York 17.
*Electro Refractories & Alloys Corp., 344 Delaware Ave., Buffalo, N.Y.
*Niagara Falls Smelting & Refining Div., Continental-United Industries Co., Inc., 2204-14 Elmwood Ave., Buffalo 17, N.Y.
Tennessee Products & Chemical Corp., American National Bank Bldg., Nashville 3.
Vanadium Corp. of America, 420 Lexington Ave., New York 17.

ALLOYS (Non-Ferrous)

*Alter Co., 1701 Rockingham Rd., Davenport, Ia.
*Bohn Aluminum & Brass Corp., Aluminum Refiners Div., 1400 Lafayette Bldg., Detroit 26.
*Bohn Aluminum & Brass Corp., Michigan Smelting & Refining Div., 1400 Lafayette Bldg., Detroit 26.
*Christiansen Corp., 1 N. LaSalle St., Chicago 2.
*City Pattern Foundry & Machine Co., 1161 Harper Ave., Detroit 11.
Colonial Smelting & Refining Co., 2nd & Linden Sts., Columbia, Pa.
*Duquesne Smelting Corp., 50 Thirty-third St., Pittsburgh 1.
*Electro Metallurgical Co., 30 E. 42nd St., New York 17.
*Electro Refractories & Alloys Corp., 344 Delaware Ave., Buffalo, N.Y.
*Federated Metals Div., American Smelting & Refining Co., 120 Broadway, New York 5.
Samuel Greenfield Co., Inc., 31 Stone St., Buffalo, N.Y.
*International Nickel Co., Inc., 67 Wall St., New York 5.
Interstate Smelting & Refining Co., 332 S. Michigan Ave., Chicago.
*H. Kramer & Co., 1345 W. 21st St., Chicago.
*R. Lavin & Sons, Inc., 3426 S. Kedzie Ave., Chicago 23.
Nassau Smelting & Refining Co., Inc., 1 Nassau Place, Tottenville, Staten Island 7, N.Y.
*Niagara Falls Smelting & Refining Div., Continental-United Industries Co., Inc., 2204-14 Elmwood Ave., Buffalo 17, N.Y.
*North American Smelting Co., Edgemont & Tioga Sts., Philadelphia 34.
*Silverstein & Pinsof, Inc., 1720 Elston Ave., Chicago 22.
*U.S. Reduction Co., East Chicago, Ind.
*Hyman Viener & Sons, 5300 Hatcher St., Richmond, Va.
White Bros. Smelting Corp., Richmond & Hedley Sts., Philadelphia 37.

ALLOYS (Special)

*Electro Metallurgical Co., 30 E. 42nd St., New York 17.

BAND SAW MACHINES (Friction Cutting)

Grob Brothers, Grafton, Wis.

BELTING

DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
*E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33.
*Manhattan Rubber Div., Raybestos-Manhattan, Inc., 61 Willett St., Passaic, N.J.

BLAST CLEANING EQUIPMENT (Air)

*Alloy Metal Abrasive Co., 311 W. Huron St., Ann Arbor, Mich.
Macleod Co., 2232-40 Bogen St., Cincinnati 22.
*Pangborn Corp., Hagerstown, Md.
*Pittsburgh Crushed Steel Co., 4839 Harrison St., Pittsburgh.
A. Schraders Son, Div. of Scovill Mfg. Co., Inc., 470 Vanderbilt Ave., Brooklyn 17, N.Y.
W. W. Sly Mfg. Co., 4700 Train Ave., Cleveland.

BLAST CLEANING EQUIPMENT (Airless)

*American Wheelabrator & Equipment Corp., South Byrkit, Mishawaka, Ind.
Hydro-Blast Corp., 2550 N. Western Ave., Chicago 47.
*Pangborn Corp., Hagerstown, Md.
*Pittsburgh Crushed Steel Co., 4839 Harrison St., Pittsburgh.

BLAST CLEANING EQUIPMENT (Hydraulic)

Hydro-Blast Corp., 2550 N. Western Ave., Chicago 47.
*Pangborn Corp., Hagerstown, Md.
*Whiting Corp., 15628 Lathrop Ave., Harvey, Ill.

BLOWERS

*Ingersoll-Rand Co., 11 Broadway, New York 4.
Roots-Connersville Blower Corp., 900 W. Mount St., Connersville, Ind.
Spencer Turbine Co., 486 New Park Ave., Hartford 6, Conn.
Standard Electrical Tool Co., 2490 River Road, Cincinnati 4.
Stroman Furnace & Engineering Co., 9900 Franklin Ave., Franklin Park, Ill.
*U.S. Hoffman Machinery Corp., 99 Fourth Ave., New York 3.

BLOW VALVES

Cleveland Vibrator Co., 2828 Clinton Ave., W., Cleveland 13.
*Flex-Rite Valve & Mfg. Co., 118 S. Cheyenne, Tulsa 3.
A. Schraders Son, Div. of Scovill Mfg. Co., Inc., 470 Vanderbilt Ave., Brooklyn 17, N.Y.

BOTTOM BOARDS

*Adams Co., Fourth Street Extention, Dubuque, Ia.
*Christiansen Corp., 1 N. LaSalle St., Chicago 2.
Diamond Clamp & Flask Co., Box 256, Richmond, Ind.
*Dougherty Lumber Co., 4300 E. 68th St., Cleveland.
Industrial Fabricating, Inc., 817 Hall St., Eaton Rapids, Mich.
*Pennsylvania Chaplet Co., Ashland & E. Lewis Sts., Philadelphia 24.
*Sterling Wheelbarrow Co., 7036 W. Walker St., Milwaukee 14.

BRICK (Refractory)

G. & W. H. Corson, Inc., Plymouth Meeting, Pa.; 261 Fabian Pl., Newark, N.J.
*Electro Refractories & Alloys Corp., 344 Delaware Ave., Buffalo, N.Y.
Harbison-Walker Refractories Co., 1800 Farmers Bank Bldg., Pittsburgh 22.
*Illinois Clay Products Co., 608 S. Dearborn St., Chicago 5.
Ironton Fire Brick Co., Box 124, Ironton, Ohio.
Lava Crucible Co. of Pittsburgh, 627 Wabash Bldg., Pittsburgh 22.
*Pyro Refractories Co., Oak Hill, Ohio.
*Quigley Co., Inc., 527 Fifth Ave., New York 17.

BRINELL HARDNESS TESTER (Portable)

Andrew King, Consulting Engineer, 521 Broad Acres Rd., Narberth, Pa.

BRIQUETTING PRESSES

Grob Brothers, Grafton, Wis.
*Milwaukee Foundry Equipment Co., 3238 W. Pierce St., Milwaukee.
*Sklenar Furnace & Mfg. Co., 38 Memorial Dr., Cambridge, Mass.

BUCKETS (Clamshell)
*Blaw-Knox Div., Blaw-Knox Co., Farmers Bank Bldg., Pittsburgh 22.
Harnischfeger Corp., 4400 W. National Ave., Milwaukee 14.

BUCKETS (Elevating)
*Chain Belt Co., 1600 W. Bruce St., Milwaukee 4.
Palmer Bee Co., Detroit 12.
*Pekay Machine & Engineering Co., 100 N. LaSalle St., Chicago 2.

BUFFING AND POLISHING MACHINES
*Mall Tool Co., 7740 South Chicago Ave., Chicago 19.
Pratt & Whitney, Div. Niles Bement Pond Co., Kellerflex Dept., Charter Oak Blvd., West Hartford 1, Conn.
Standard Electrical Tool Co., 2490 River Road, Cincinnati 4.

CASTINGS (Ferrous)
Meehanite Metal Corp., Pershing Sq. Bldg., New Rochelle, N.Y.
*Wheland Co., 2727 S. Broad St., Chattanooga 2, Tenn.

CASTINGS (Non-Ferrous)
*International Nickel Co., 67 Wall St., New York 5.
*Hyman Viener & Sons, 5300 Hatcher St., Richmond, Va.

CEMENT (Refractory)
Alpha-Lux Co., Inc., 155 John St., New York 7.
American Crucible Co., North Haven, Conn.
Bay State Crucible Co., 26 Presby Ct., Taunton, Mass.
Ironton Fire Brick Co., Box 124, Ironton, Ohio.
National Crucible Co., Mermaid Lane & Queen St., Philadelphia 18.
S. Obermayer Co., 2563 W. 18th St., Chicago 8.
Pittsburgh Metals Purifying Co., 1352 Marvista St., Pittsburgh 12.
*Quigley Co., Inc., 527 Fifth Ave., New York 17.
Ramtite Co., Div. S. Obermayer Co., 2563 W. 18th St., Chicago 8.

CENTRIFUGAL CASTING MACHINES
Allis-Chalmers Mfg. Co., 1126 S. 70th St., Milwaukee 1.
Centrifugal Casting Machine Co., Box 947, Tulsa, Okla.
Herman Pneumatic Machine Co., 1806 Union Bank Bldg., Pittsburgh 22.

CERIUM METAL
General Cerium Co., 1038 River Road, Edgewater, N.J.

CHAINS (Industrial)
*Chain Belt Co., 1600 W. Bruce St., Milwaukee 4.
Chisholm-Moore Hoist Corp., Tonawanda, N.Y.
Columbus McKinnon Chain Corp., Tonawanda, N.Y.
Link-Belt Co., 300 W. Pershing Rd., Chicago 9.
*Pekay Machine & Engineering Co., 100 N. La Salle St., Chicago 2.

CHAPLETS AND NAILS
Capewell Mfg. Co., 60 Governor St., Hartford, Conn.
Combined Supply & Equipment Co., Inc., 215 Chandler St., Buffalo 7, N.Y.
*Pennsylvania Chaplet Co., Ashland & E. Lewis Sts., Philadelphia 24.
Springfield Facing Co., Harrison, N.J.; Wilimansett, Mass.
*Standard Horse Nail Corp., New Brighton, Pa.

CHEMICALS
*Mathieson Alkali Works, Inc., 60 E. 42nd St., New York 17.

CHISELS (Chipping)
Chicago Pneumatic Tool Co., 6 E. 44th St., New York 17.
Cleco Div., Reed Roller Bit Co., P.O. Box 2119, Houston 1, Texas.
Dallett Co., Mascher at Lippincott St., Philadelphia 33.
Dayton Pneumatic Tool Co., 8-10 Norwood Ave., Dayton, Ohio.

CLAY (Bonding)
*Baroid Sales Div., National Lead Co., 830 Ducommun St., Los Angeles 12.
*Carpenter Brothers, Inc., 606 W. Wisconsin Ave., Milwaukee 3.
*Eastern Clay Products, Inc., 223 Main St., Jackson, Ohio.
*Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5.
*Illinois Clay Products Co., 608 S. Dearborn St., Chicago 5.
*Pyro Refractories Co., Oak Hill, Ohio.
Stoller Chemical Co., 31 N. Summit St., Akron, Ohio.
Whitehead Brothers Co., 324 W. 23rd St., New York 11.
*Wyotana Mining Co., 331 First Federal Bldg., St. Paul 1, Minn.

CLAY (Fire)
G. & W. H. Corson, Inc., Plymouth Meeting, Pa.; 261 Fabian Pl., Newark, N.J.
*Eastern Clay Products, Inc., 223 Main St., Jackson, Ohio.
*Great Lakes Foundry Sand Co., 720 United Artists Bldg., Detroit 26.
*Illinois Clay Products Co., 608 S. Dearborn St., Chicago 5.
National Foundry Sand Co., 2970 W. Grand Blvd., Detroit 2.
New Jersey Silica Sand Co., Box 71, Millville, N.J.
*Pyro Refractories Co., Oak Hill, Ohio.

CLEANING (Surface Treatment)
N. Ransohoff, Inc., 16 E. 72nd St., Cincinnati 16.

COKE (Foundry)
Debevoise-Anderson Co., Inc., New York; Philadelphia; Boston; New Haven, Conn.
*Hickman-Williams & Co., Cleveland; Chicago; Cincinnati; St. Louis; Pittsburgh; Philadelphia; New York; Detroit.
Republic Coal & Coke Co., Willoughby Tower, 8 S. Michigan Ave., Chicago 3.
*Semet-Solvay Div., Allied Chemical & Dye Corp., 40 Rector St., New York 6.
Tennessee Products & Chemical Corp., American National Bank Bldg., Nashville 3.

COKE (Petroleum)
Debevoise-Anderson Co., Inc., New York; Philadelphia; Boston; New Haven, Conn.
Republic Coal & Coke Co., Willoughby Tower, 8 S. Michigan Ave., Chicago 3.

CONVERTERS (Side Blow)
*Whiting Corp., 15628 Lathrop Ave., Harvey, Ill.

CONVEYING AND MATERIALS HANDLING EQUIPMENT
Ajax Flexible Coupling Co., Inc., Cor. English & Portage Sts., Westfield, N.Y.
C. O. Bartlett & Snow Co., 6200 Harvard Ave., Cleveland 5.
Bell Aircraft Corp., P.O. Box 1, Buffalo 5, N.Y.
*Butler Bin Co., Carscoop Div., Waukesha, Wis.
*Chain Belt Co., 1600 W. Bruce St., Milwaukee 4.
Chisholm-Moore Hoist Corp., Tonawanda, N.Y.
Dings Magnetic Separator Co., 4740 McGeogh Ave., Milwaukee.
*Engineering Service, Inc., 610 W. Michigan St., Milwaukee 3.
*Hyster Co., 2902 N.E. Clackamas, Portland, Ore.
*Jeffrey Mfg. Co., 977 N. Fourth St., Columbus 16, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago 9.
*Logan Co., 201 Cabel St., Louisville 6, Ky.
Material Movement Industries, Inc., 9257 Laramie Ave., Skokie, Ill.
Mathews Conveyor Co., Ellwood City, Pa.
*Modern Equipment Co., 360 S. Spring St., Port Washington, Wis.
*National Engineering Co., 549 W. Washington Blvd., Chicago 6.
Newaygo Engineering Co., Newaygo, Mich.
Palmer Bee Co., Detroit 12.
*Pekay Machine & Engineering Co., 100 N. LaSalle St., Chicago 2.
Robins Conveyors Div., Hewitt-Robins, Inc., 270 Passaic Ave., Passaic, N.J.
*Royer Foundry & Machine Co., 158 Pringle St., Kingston, Pa.
*Silent Hoist & Crane Co., Inc., 841-65 Sixty-third St., Brooklyn 20, N.Y.
Standard Conveyor Co., N. St. Paul 9, Minn.
Syntron Co., Homer City, Pa.
*U.S. Reduction Co., East Chicago, Ind.
*Jervis B. Webb Co., 8951 Alpine Ave., Detroit 4.
*Whiting Corp., 15628 Lathrop Ave., Harvey, Ill.
Yale & Towne Mfg. Co., 4530 Tacony St., Philadelphia 24.

CORE AND MOLD WASHES
Bloomsbury Graphite Co., 30 Church St., Bloomsbury, N.J.
Casein Co. of America, Div. of The Borden Co., 350 Madison Ave., New York 17.
*Dayton Oil Co., P.O. Box 851, 1201 E. Monument Ave., Dayton 1.
*Delta Oil Products Co., 6263 N. Cedarburg Rd., Milwaukee 9.
*Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5.
Harbison-Walker Refractories Co., 1800 Farmers Bank Bldg., Pittsburgh 22.
Hougland & Hardy, Hardy Sand Co., 507 S.E. 2nd St., Evansville, Ind.
Lauhoff Grain Co., Allbond Corebinder Div., Danville, Ill.
J. S. McCormick Co., 25th St. & A. V. RR., Pittsburgh 22.
National Pulverizing Co., Millville, N.J.
S. Obermayer Co., 2563 W. 18th St., Chicago 8.
*Ottawa Silica Co., Box 437, Ottawa, Ill.
*Pennsylvania Foundry Supply & Sand Co., Ashland & E. Lewis Sts., Philadelphia 24.
Ramtite Co., Div. of S. Obermayer Co., 2563 W. 18th St., Chicago 8.
*Smith Facing & Supply Co., 1857 Carter Rd., Cleveland 13.
Smith Oil & Refining Co., Rockford, Ill.
Springfield Facing Co., Harrison, N.J.; Wilimansett, Mass.
*Frederic B. Stevens, Inc., 1800 18th St., Detroit 16.
Thiem Products, Inc., 647 W. Virginia St., Milwaukee.
United Oil Mfg. Co., 1429-31 Walnut St., Erie, Pa.
Whitehead Brothers Co., 324 W. 23rd St., New York 11.

CORE BINDERS, OILS AND COMPOUNDS
Casein Co. of America, Div. of The Borden Co., 350 Madison Ave., New York 17.
Corn Products Sales Co., 17 Battery Pl., New York 4.
*Dayton Oil Co., P.O. Box 851, 1201 E. Monument Ave., Dayton 1.
*Delta Oil Products Co., 6263 N. Cedarburg Rd., Milwaukee 9.
*Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5.
Hercules Powder Co., Inc., Wilmington 99, Del.
Hill & Griffith Co., Cincinnati 4; Birmingham 1; Chicago 50.
*E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33.
*Chas. A. Krause Milling Co., 404 E. State St., Milwaukee.
Lauhoff Grain Co., Allbond Corebinder Div., Danville, Ill.
J. S. McCormick Co., 25th St. & A. V. RR., Pittsburgh 22.
*Pennsylvania Foundry Supply & Sand Co., Ashland & E. Lewis Sts., Philadelphia 24.
*Penola, Inc., 221 N. LaSalle St., Chicago 1.
George F. Pettinos, Inc., 1206 Locust St., Philadelphia 7.
Randall Foundry Equipment Corp., Newburgh Station, Cleveland 5.
*Smith Facing & Supply Co., 1857 Carter Rd., Cleveland 13.
Smith Oil & Refining Co., Rockford, Ill.
*Werner G. Smith Co., Div. of Archer-Daniels-Midland Co., 2191 W. 110th St., Cleveland 2.
Springfield Facing Co., Harrison, N.J.; Wilimansett, Mass.
Stoller Chemical Co., 31 N. Summit St., Akron, Ohio.
*Swan-Finch Oil Corp., R.C.A. Bldg., West, New York 20.
Thiem Products, Inc., 647 W. Virginia St., Milwaukee.
United Oil Mfg. Co., 1429-31 Walnut St., Erie, Pa.
*Velsicol Corp., 330 E. Grand Ave., Chicago 11.

CORE BLOWERS
Champion Foundry & Machine Co., 1316 W. 21st St., Chicago 8.
Wm. Demmler & Bros., Kewanee, Ill.
International Molding Machine Co., P.O. Box 310, LaGrange Park, Ill.
Martin Engineering Co., 704 Rose St., Kewanee, Ill.
*Milwaukee Foundry Equipment Co., 3238 W. Pierce St., Milwaukee, Wis.
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland 14.
*Plastic Corp. of Chicago, 2444 S. Central Ave., Chicago 50.
Redford Iron & Equipment Co., 21315 W. McNichols Road, Detroit 19.
*Sklenar Furnace & Mfg. Co., 38 Memorial Dr., Cambridge, Mass.

CORE BOX CLEANER
Casein Co. of America, Div. of The Borden Co., 350 Madison Ave., New York 17.
*Delta Oil Products Co., 6263 N. Cedarburg Rd., Milwaukee 9.
*E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33.
*Smith Facing & Supply Co., 1857 Carter Rd., Cleveland 13.
United Oil Mfg. Co., 1429-31 Walnut St., Erie, Pa.

CORE CONVEYING EQUIPMENT
*Logan Co., 201 Cabel St., Louisville 6, Ky.
Mathews Conveyer Co., Ellwood City, Pa.
Palmer-Bee Co., Detroit 12.
*Sklenar Furnace & Mfg. Co., 38 Memorial Dr., Cambridge, Mass.
*Sterling Wheelbarrow Co., 7036 W. Walker St., Milwaukee 14.
*Jervis B. Webb Co., 8951 Alpine Ave., Detroit 4.

CORE CRUSHERS
*Jeffrey Mfg. Co., 977 N. Fourth St., Columbus 16, Ohio.
Newaygo Engineering Co., Newaygo, Mich.
*Sklenar Furnace & Mfg. Co., 38 Memorial Dr., Cambridge, Mass.

CORE GRINDERS
*Milwaukee Foundry Equipment Co., 3238 W. Pierce St., Milwaukee, Wis.

CORE KNOCKOUT EQUIPMENT
Dayton Pneumatic Tool Co., 8-10 Norwood Ave., Dayton, Ohio.
Hydro-Blast Corp., 2550 N. Western Ave., Chicago 47.
*Pangborn Corp., Hagerstown, Md.
Robins Conveyors Div., Hewitt-Robins Inc., 270 Passaic Ave., Passaic, N.J.

CORE MAKING MACHINES
Arcade Mfg. Div., Rockwell Mfg. Co., 600 E. Vienna Ave., Milwaukee 1.
Champion Foundry & Machine Co., 1316 W. 21st St., Chicago 8.
Crescent Machine Div., Rockwell Mfg. Co., 600 E. Vienna Ave., Milwaukee 1.
Delta Mfg. Div., Rockwell Mfg. Co., 600 E. Vienna Ave., Milwaukee 1.
Wm. Demmler & Bros., Kewanee, Ill.
Herman Pneumatic Machine Co., 1806 Union Bank Bldg., Pittsburgh 22.
International Molding Machine Co., P.O. Box 310, LaGrange Park, Ill.
*Johnston & Jennings Co., 877 Addison Rd., Cleveland.
*Sklenar Furnace & Mfg. Co., 38 Memorial Dr., Cambridge, Mass.
*Tabor Mfg. Co., 6225 Tacony St., Philadelphia 35.

CORE OVENS
*Foundry Equipment Co., 1831 Columbus Rd., Cleveland 13.
Induction Heating Corp., 181 Wythe Ave., Brooklyn 11, N.Y.
*Kirk & Blum Mfg. Co., 2876 Spring Grove Ave., Cincinnati.
*Young Bros. Co. 6500 Mack Ave., Detroit 7.

CORE PASTE
Casein Co. of America, Div. of The Borden Co., 350 Madison Ave., New York 17.
*Eastern Clay Products, Inc., 223 Main St., Jackson, Ohio.
Hill & Griffith Co., Cincinnati 4; Birmingham 1; Chicago 50.
Lauhoff Grain Co., Allbond Corebinder Div., Danville, Ill.
*Smith Facing & Supply Co., 1857 Carter Rd., Cleveland 13.
Whitehead Brothers Co., 324 W. 23rd St., New York 11.

CORE PLATES
*Christiansen Corp., 1 N. LaSalle St., Chicago 2.
Diamond Clamp & Flask Co., Box 256, Richmond, Ind.
Industrial Fabricating, Inc., 817 Hall St., Eaton Rapids, Mich.
*Sterling Wheelbarrow Co., 7036 W. Walker St., Milwaukee 14.

CORE RACKS
Industrial Fabricating, Inc., 817 Hall St., Eaton Rapids, Mich.
*Kirk & Blum Mfg. Co., 2876 Spring Grove Ave., Cincinnati.

CORE ROD STRAIGHTENERS AND SHEARING MACHINERY
*Alter Co., 1701 Rockingham Rd., Davenport, Ia.
*Kane & Roach, Inc., Niagara & Shonnard Sts., Syracuse 4, N.Y.
*Pennsylvania Chaplet Co., Ashland & E. Lewis Sts., Philadelphia 24.
Redford Iron & Equipment Co., 21315 W. McNichols Rd., Detroit 19.

CORE ROOM EQUIPMENT
*Beardsley & Piper Co., Div. of Pettibone Mulliken Corp., 2424 N. Cicero Ave., Chicago 39.
Wm. Demmler & Bros., Kewanee, Ill.
Freeman Supply Co., 1152 E. Broadway, Toledo 5, Ohio.

CORE SAND RECLAMATION
Hougland & Hardy, Hardy Sand Co., 507 S.E. 2nd St., Evansville, Ind.
Hydro-Blast Corp., 2550 N. Western Ave., Chicago 47.
Lauhoff Grain Co., Allbond Corebinder Div., Danville, Ill.
Manley Sand Co., Rockton, Ill.
*National Engineering Co., 549 W. Washington Blvd., Chicago 6.
*Nichols Engineering & Research Corp., 60 Wall Tower, New York.
*Ottawa Silica Co., Box 437, Ottawa, Ill.
Taggart & Co., 6903 Torresdale Ave., Philadelphia 35.

CORE VENTS
Combined Supply & Equipment Co., Inc., 215 Chandler St., Buffalo 7, N.Y.
Wm. Demmler & Bros., Kewanee, Ill.
P.M.S. Co., 1071 Power Ave., Cleveland 14.
United Compound Co., 328 S. Park Ave., Buffalo, N.Y.

COUPLINGS (Flexible)
Ajax Flexible Coupling Co., Inc., Cor. English & Portage Sts., Westfield, N.Y.

CRANES (Foundry)
Harnischfeger Corp., 4400 W. National Ave., Milwaukee, 14.
*Hyster Co., 2902 N.E. Clackamas, Portland, Ore.
*Modern Equipment Co., 360 S. Spring St., Port Washington, Wis.
*Whiting Corp., 15628 Lathrop Ave., Harvey, Ill.

CRANES (Tractor)
*Hyster Co., 2902 N.E. Clackamas, Portland, Ore.
*Silent Hoist & Crane Co., Inc., 841-865 Sixty-third St., Brooklyn 20, N.Y.

CRUCIBLES
American Crucible Co., North Haven, Conn.
Bay State Crucible Co., 26 Presby Ct., Taunton, Mass.
Joseph Dixon Crucible Co., Jersey City 3, N.J.
Lava Crucible Co. of Pittsburgh, 627 Wabash Bldg., Pittsburgh 22.
National Crucible Co., Mermaid Lane & Queen St., Philadelphia 18.
Randall Foundry Equipment Corp., Newburgh Station, Cleveland 5.
Ross-Tacony Crucible Co., Robbins & Milnar Sts., Tacony 1, Pa.
Vesuvius Crucible Co., Swissvale, Pittsburgh 18.

CUPOLA BLOWERS
Allis-Chalmers Mfg. Co., 1126 S. 70th St., Milwaukee 1.
Roots-Connersville Blower Corp., 900 W. Mount St., Connersville, Ind.
Spencer Turbine Co., 486 New Park Ave., Hartford 6, Conn.

CUPOLA CHARGERS
Harnischfeger Corp., 4400 W. National Ave., Milwaukee 14.
*Modern Equipment Co., 360 S. Spring St., Port Washington, Wis.
*Whiting Corp., 15628 Lathrop Ave., Harvey, Ill.

CUPOLA CONTROL EQUIPMENT
Foxboro Co., 36 Neponset Ave., Foxboro, Mass.

CUPOLA DUST COLLECTORS
*Claude B. Schneible Co., 2827 - 25th St., Detroit.

CUPOLA LIGHTING TORCHES
Macleod Co., 2232-40 Bogen St., Cincinnati 22.

CUPOLAS
*Modern Equipment Co., 360 S. Spring St., Port Washington, Wis.
*Tabor Mfg. Co., 6225 Tacony St., Philadelphia 35.
*Whiting Corp., 15628 Lathrop Ave., Harvey, Ill.

CUTOFF MACHINES
DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
Grob Brothers, Grafton, Wis.
*Kane & Roach, Inc., Niagara & Shonnard Sts., Syracuse 4, N.Y.
*Oliver Machinery Co., 1025 Clancy Ave., Grand Rapids 2, Mich.

DIES
Bullard Gage Co., 17168 Redford Ave., Detroit 19.

DUST COLLECTING EQUIPMENT (Dry)
*Alloy Metal Abrasive Co., 311 W. Huron St., Ann Arbor, Mich.
*American Air Filter Co., Inc., 215 Central Ave., Louisville, Ky.
*American Wheelabrator & Equipment Corp., 630 S. Byrkit St., Mishawaka, Ind.
Johnson-March Corp., Drexel Bldg., Philadelphia 6.
*Kirk & Blum Mfg. Co., 2876 Spring Grove Ave., Cincinnati.
Macleod Co., 2232-40 Bogen St., Cincinnati 22.
*Pangborn Corp., Hagerstown, Md.
W. W. Sly Mfg. Co., 4700 Train Ave., Cleveland.
Standard Electrical Tool Co., 2490 River Rd., Cincinnati 4.
*U.S. Hoffman Machinery Corp., 99 Fourth Ave., New York 3.

DUST COLLECTING EQUIPMENT (Wet)
*American Air Filter Co., Inc., 215 Central Ave., Louisville, Ky.
C. O. Bartlett & Snow Co., 6200 Harvard Ave., Cleveland 5.
*Kirk & Blum Mfg. Co., 2876 Spring Grove Ave., Cincinnati.
*Claude B. Schneible Co., 2827 - 25th St., Detroit, Mich.
*Tabor Mfg. Co., 6225 Tacony St., Philadelphia 35.
*Whiting Corp., 15628 Lathrop Ave., Harvey, Ill.

ELECTRODES
Air Reduction Sales Co., 42nd St., opposite Grand Central, New York 17.
Arcos Corp., 1515 Locust St., Philadelphia 2.
International Graphite & Electrode Corp., St. Marys, Pa.
*International Nickel Co., Inc., 67 Wall St., New York 5.
*National Carbon Co., Inc., 30 E. 42nd St., New York 17.

ENGINEERING SERVICE (Foundry)
Ajax Engineering Corp., Lalor & Hancock Sts., Trenton, N.J.
*Engineering Service, Inc., 610 W. Michigan St., Milwaukee 3.
Fellows Corp., 1012 N. Third St., Milwaukee 3.
*Charles C. Kawin Co., 431 Dearborn St., Chicago 5; 110 Pearl St., Buffalo 2, N.Y.
*Lester B. Knight & Associates, 600 W. Jackson Blvd., Chicago.
Ottes E. Paris, Fdry. Ind. Engr., 111 W. Jackson Blvd., Chicago.
*Pekay Machine & Engineering Co., 100 N. LaSalle St., Chicago 2.
Standard Sand & Machine Co., 549 W. Washington Blvd., Chicago 6.
*U.S. Reduction Co., East Chicago, Ind.
*Whitehead, Sanger & Hoidge, 36 W. 40th St., New York 18.

EXOTHERMIC MATERIALS (Anti-piping Compounds)
National Pigment Co., 2117 E. York St., Milville, N.J.

EXOTHERMIC MATERIALS (Pipe Eliminators)
Exomet, Inc., Conneaut, Ohio.

FACINGS (Foundry)
Asbury Graphite Mills, Inc., Asbury, N.J.
Bloomsbury Graphite Co., 30 Church St., Bloomsbury, N.J.
*Delta Oil Products Co., 6263 N. Cedarburg Rd., Milwaukee 9.
Joseph Dixon Crucible Co., Jersey City 3, N.J.
*Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5.
Harbison-Walker Refractories Co., 1800 Farmers Bank Bldg., Pittsburgh 22.
Hill & Griffith Co., Cincinnati 4; Birmingham 1; Chicago 50.
J. S. McCormick Co., 25th St. & A. V. RR., Pittsburgh 22.
S. Obermayer Co., 2563 W. 18th St., Chicago 8.

Penn-Rillton Co., 324 W. 23rd St., New York 11.
George F. Pettinos, Inc., 1206 Locust St., Philadelphia 7.
Ramtite Co., Div. of S. Obermayer Co., 2563 W. 18th St., Chicago 8.
*Smith Facing & Supply Co., 1857 Carter Rd., Cleveland 13.
Springfield Facing Co., Harrison, N.J.; Willimansett, Mass.
*Frederic B. Stevens, Inc., 1800 18th St., Detroit 16.
Stoller Chemical Co., 31 N. Summit St., Akron, Ohio.
Thiem Products, Inc., 674 W. Virginia St., Milwaukee.
United States Graphite Co., 1621 Holland Ave., Saginaw, Mich.
Whitehead Brothers Co., 324 W. 23rd St., New York 11.

FERRO-ALLOYS

*Climax Molybdenum Co., 500 Fifth Ave., New York 18.
Exothermic Alloys Sales & Service, Inc., 301 E. 138th St., Chicago 27.
*Hickman, Williams & Co., Cleveland; Chicago; Cincinnati; St. Louis; Pittsburgh; Philadelphia; New York; Detroit.

FIRE BRICK

G. & W. H. Corson, Inc., Plymouth Meeting, Pa.; 261 Fabian Pl., Newark, N.J.
Delhi Foundry Sand Co., 6326 River Road, Cincinnati 33.
Harbison-Walker Refractories Co., 1800 Farmers Bank Bldg., Pittsburgh 22.
*Illinois Clay Products Co., 608 S. Dearborn St., Chicago 5.
Ironton Fire Brick Co., Box 124, Ironton, Ohio.
*Pyro Refractories Co., Oak Hill, Ohio.
*Quigley Co., Inc., 527 Fifth Ave., New York 17.

FLASK LUMBER

*Dougherty Lumber Co., 4300 E. 68th St., Cleveland.

FLASKS (Aluminum)

*Adams Co., Fourth Street Extension, Dubuque, Ia.
Hines Flask Co., 3431 W. 140th St., Cleveland 11.

FLASKS (Magnesium)

Fremont Flask Co., 1000 Wolfe Ave., Fremont, Ohio.

FLASKS (Steel)

Hines Flask Co., 3431 W. 140th St., Cleveland 11.
Industrial Fabricating, Inc., 817 Hall St., Eaton Rapids, Mich.
*Sterling Wheelbarrow Co., 7036 W. Walker St., Milwaukee 14.

FLASKS (Wood)

*Adams Co., Fourth Street Extension, Dubuque, Ia.
Arcade Mfg. Div., Rockwell Mfg. Co., 600 E. Vienna Ave., Milwaukee 1.
Crescent Machine Div., Rockwell Mfg. Co., 600 E. Vienna Ave., Milwaukee 1.
Delta Mfg. Div., Rockwell Mfg. Co., 600 E. Vienna Ave., Milwaukee 1.
Diamond Clamp & Flask Co., Box 256, Richmond, Ind.
*Dougherty Lumber Co., 4300 E. 68th St., Cleveland.

FLASK TRIMMING AND JACKETS

*Adams Co., Fourth Street Extension, Dubuque, Ia.
Arcade Mfg. Div., Rockwell Mfg. Co., 600 E. Vienna Ave., Milwaukee 1.
Crescent Machine Div., Rockwell Mfg. Co., 600 E. Vienna Ave., Milwaukee 1.
Delta Mfg. Div., Rockwell Mfg. Co., 600 E. Vienna Ave., Milwaukee 1.
Diamond Clamp & Flask Co., Box 256, Richmond, Ind.
Hines Flask Co., 3431 W. 140th St., Cleveland 11.
Industrial Fabricating, Inc., 817 Hall St., Eaton Rapids, Mich.
S. Obermayer Co., 2563 W. 18th St., Chicago 8.
George F. Pettinos, Inc., 1206 Locust St., Philadelphia 7.
Ramtite Co., Div. of S. Obermayer Co., 2563 W. 18th St., Chicago 8.

FLEXIBLE SHAFT EQUIPMENT

*Mall Tool Co., 7740 South Chicago Ave., Chicago 19.
Martindale Electric Co., 1349 Hird Ave., Cleveland 7.
Pratt & Whitney, Div. Niles Bement Pond Co., Kellerflex Dept., Charter Oak Blvd., West Hartford 1, Conn.

FLUORSPAR

Delhi Foundry Sand Co., 6326 River Road, Cincinnati 33.

FLUXES (Aluminum)

*Apex Smelting Co., 2537 W. Taylor St., Chicago 12; 6700 Grant Ave., Cleveland 5.

FLUXES (Cupola)

*Cleveland Flux Co., 1026-36 Main Ave., N.W., Cleveland 13.
*Mathieson Alkali Works, Inc., 60 E. 42nd St., New York 17.
Pittsburgh Metals Purifying Co., 1352 Marvista St., Pittsburgh 12.
Thiem Products, Inc., 647 W. Virginia St., Milwaukee.

FLUXES (Non-Ferrous)

*Cleveland Flux Co., 1026-36 Main Ave., N.W., Cleveland 13.
*Mathieson Alkali Works, Inc., 60 E. 42nd St., New York 17.
*Niagara Falls Smelting & Refining Div., Continental-United Industries Co., Inc., 2204-14 Elmwood Ave., Buffalo 17, N.Y.
Pittsburgh Metals Purifying Co., 1352 Marvista St., Pittsburgh 12.
Thiem Products, Inc., 647 W. Virginia St., Milwaukee.
*U.S. Reduction Co., East Chicago, Ind.
*Hyman Viener & Sons, 5300 Hatcher St., Richmond, Va.

FLUXES (Welding)

Air Reduction Sales Co., 42nd St., opposite Grand Central, New York 17.
Linde Air Products Co., 30 E. 42nd St., New York 17.
Pittsburgh Metals Purifying Co., 1352 Marvista St., Pittsburgh 12.

FOUNDRY SUPPLIES (General)

*Alter Co., 1701 Rockingham Rd., Davenport, Ia.
*Cleveland Flux Co., 1026-36 Main Ave., N.W., Cleveland 13.
Combined Supply & Equipment Co., Inc., 215 Chandler St., Buffalo 7, N.Y.
*Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5.
*General Handle Co., Rice Lake, Wis.
Hill & Griffith Co., Cincinnati 4; Birmingham 1; Chicago 50.
J. S. McCormick Co., 25th St. & A. V. RR., Pittsburgh 22.
S. Obermayer Co., 2563 W. 18th St., Chicago 8.
*Pennsylvania Chaplet Co., Ashland & E. Lewis Sts., Philadelphia 24.
Ramtite Co., Div. of S. Obermayer Co., 2563 W. 18th St., Chicago 8.
Springfield Facing Co., Harrison, N.J.; Willimansett, Mass.
*Frederic B. Stevens, Inc., 1800 18th St., Detroit 16.
*Jervis B. Webb Co., 8951 Alpine Ave., Detroit 4.

FURNACE LININGS

Ajax Electrothermic Corp., Ajax Park, Trenton 5, N.J.
Alpha-Lux Co., Inc., 155 John St., New York 7.
American Crucible Co., North Haven, Conn.
Bay State Crucible Co., 26 Presby Ct., Taunton, Mass.
Campbell-Hausfeld Co., 300-320 Moore St., Harrison, Ohio.
Harbison-Walker Refractories Co., 1800 Farmers Bank Bldg., Pittsburgh 22.
Lava Crucible Co. of Pittsburgh, 627 Wabash Bldg., Pittsburgh 22.
*National Carbon Co., 30 E. 42nd St., New York 17.
National Crucible Co., Mermaid Lane & Queen St., Philadelphia 18.
Stroman Furnace & Engineering Co., 9900 Franklin Ave., Franklin Park, Ill.

FURNACES (Aluminum and Magnesium Melting)

Ajax Electrothermic Corp., Ajax Park, Trenton, N.J.
Ajax Engineering Corp., Lalor & Hancock Sts., Trenton, N.J.
*Ajax Metal Co., 46 Richmond St., Philadelphia 23.
Campbell-Hausfeld Co., 300-320 Moore St., Harrison, Ohio.
*Lindberg Engineering Co., 2450 W. Hubbard St., Chicago 12.
*Sklenar Furnace & Mfg. Co., 38 Memorial Dr., Cambridge, Mass.
Stroman Furnace & Engineering Co., 9900 Franklin Ave., Franklin Park, Ill.

FURNACES (Crucible)

Ajax Electrothermic Corp., Ajax Park, Trenton 5, N.J.
Campbell-Hausfeld Co., 300-320 Moore St., Harrison, Ohio.
*Lindberg Engineering Co., 2450 W. Hubbard St., Chicago 12.
Randall Foundry Equipment Corp., Newburgh Station, Cleveland 5.
Stroman Furnace & Engineering Co., 9900 Franklin Ave., Franklin Park, Ill.

FURNACES (Electric)

Ajax Electrothermic Corp., Ajax Park, Trenton 5, N.J.
Ajax Engineering Corp., Lalor & Hancock Sts., Trenton, N.J.
*Ajax Metal Co., 46 Richmond St., Philadelphia 23.
*American Bridge Co., U.S. Steel Corp. Subsidiary, 440 Fifth Ave., Pittsburgh.
*Despatch Oven Co., 619 S.E. 8th St., Minneapolis.
*Detroit Electric Furnace Div., Kuhlman Electric Co., 1000 26th St., Bay City, Mich.
*Lindberg Engineering Co., 2450 W. Hubbard St., Chicago 12.
*Pittsburgh Lectromelt Furnace Corp., Foot of 82nd St., Pittsburgh.
*Salem Engineering Co., Salem, Ohio.
*Whiting Corp., 15628 Lathrop Ave., Harvey, Ill.

FURNACES (Gas or Oil Fired)

Ajax Electrothermic Corp., Ajax Park, Trenton 5, N.J.
Campbell-Hausfeld Co., 300-320 Moore St., Harrison, Ohio.
*Despatch Oven Co., 619 S.E. 8th St., Minneapolis.
*Foundry Equipment Co., 1831 Columbus Rd., Cleveland 13.
*Lindberg Engineering Co., 2450 W. Hubbard St., Chicago 12.
Randall Foundry Equipment Corp., Newburgh Station, Cleveland 5.
*Salem Engineering Co., Salem, Ohio.
*Sklenar Furnace & Mfg. Co., 38 Memorial Dr., Cambridge, Mass.
Stroman Furnace & Engineering Co., 9900 Franklin Ave., Franklin Park, Ill.

FURNACES (Heat Treating)

Ajax Electrothermic Corp., Ajax Park, Trenton 5, N.J.
*Ajax Metal Co., 46 Richmond St., Philadelphia 23.
*Despatch Oven Co., 619 S.E. 8th St., Minneapolis.
DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
*Foundry Equipment Co., 1831 Columbus Rd., Cleveland 13.
*Lindberg Engineering Co., 2450 W. Hubbard St., Chicago 12.
*Salem Engineering Co., Salem, Ohio.
*Sklenar Furnace & Mfg. Co., 38 Memorial Dr., Cambridge, Mass.
*Lee Wilson Engineering Co., Inc., 20005 W. Lake Rd., Cleveland 16.

GAGES

Bullard Gage Co., 17168 Redford Ave., Detroit 19.

GOGGLES

Air Reduction Sales Co., 42nd St., opposite Grand Central, New York 17.
American Optical Co., 14 Mechanic St., Southbridge, Mass.
Clersite Co., 2508 W. Van Buren St. Chicago 12.
Mine Safety Appliances Co., Braddock, Thomas & Meade Sts., Pittsburgh 8.
Pulmosan Safety Equipment Corp., 176 Johnson St., Brooklyn 1, N.Y.
Safety Clothing & Equipment Co., 7016 Euclid Ave., Cleveland.

GRAPHITE PRODUCTS

American Crucible Co., North Haven, Conn.
Asbury Graphite Mills, Inc., Asbury, N.J.
Bloomsbury Graphite Co., 30 Church St., Bloomsbury, N.J.
Joseph Dixon Crucible Co., Jersey City 3, N.J.
International Graphite & Electrode Corp., St. Marys, Pa.
Lava Crucible Co. of Pittsburgh, 627 Wabash Bldg., Pittsburgh 22.
*National Carbon Co., Inc., 30 E. 42nd St., New York 17.
National Crucible Co., Mermaid Lane & Queen St., Philadelphia 18.
George F. Pettinos, Inc., 1206 Locust St., Philadelphia 7.
*Smith Facing & Supply Co., 1857 Carter Rd., Cleveland 13.
Stoller Chemical Co., 31 N. Summit St., Akron, Ohio.
United States Graphite Co., 1621 Holland Ave., Saginaw, Mich.
Vesuvius Crucible Co., Swissvale, Pittsburgh 18.

GRAPHITE STOPPER HEADS
Joseph Dixon Crucible Co., Jersey City 3, N.J.
*National Carbon Co., Inc., 30 E. 42nd St., New York 17.
Ross-Tacony Crucible Co., Robbins & Milnar Sts., Tacony 1, Pa.
Vesuvius Crucible Co., Swissvale, Pittsburgh 18.

GRINDERS (Electric)
Buckeye Tools Corp., 29 W. Apple St., Dayton, Ohio.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York 17.
DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
Fox Grinders, Inc., 622 Oliver Bldg., Pittsburgh 22.
*Mall Tool Co., 7740 South Chicago Ave., Chicago 19.
Standard Electrical Tool Co., 2490 River Rd., Cincinnati 4.
Syntron Co., Homer City, Pa.

GRINDERS (Flexible Shaft)
*Mall Tool Co., 7740 South Chicago Ave., Chicago 19.
Martindale Electric Co., 1349 Hird Ave., Cleveland 7.
Pratt & Whitney, Div. Niles Bement Pond Co., Kellerflex Dept., Charter Oak Blvd., West Hartford 1, Conn.

GRINDERS (Pneumatic)
Buckeye Tools Corp., 29 W. Apple St., Dayton, Ohio.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York 17.
Cleco Div., Reed Roller Bit Co., P.O. Box 2119, Houston 1, Texas.
Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago.
Master Pneumatic Tool Co., Inc., Orwell, Ohio.
Rotor Tool Co., 17325 Euclid Ave., Cleveland 12.

GRINDERS (Swing Frame)
Fox Grinders, Inc., 622 Oliver Bldg., Pittsburgh 22.

GRINDING WHEELS
*Bay State Abrasive Products Co., Union St., Westboro, Mass.
DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
*Electro Refractories & Alloys Corp., 344 Delaware Ave., Buffalo, N.Y.
*Manhattan Rubber Div., Raybestos-Manhattan, Inc., 61 Willett St., Passaic, N.J.
*Peninsular Grinding Wheel Co., 729 Meldrum Ave., Detroit 7.
George Pfaff, Inc., 10-61 Jackson Ave., Long Island City 1, N.Y.
Precision Grinding Wheel Co. Inc., 8301 Torresdale Ave., Philadelphia 36.
*Simonds Abrasive Co., Tacony & Fraley Sts., Philadelphia 37.
*Sterling Grinding Wheel Div., Cleveland Quarries Co., Tiffin 3, Ohio.
United States Rubber Co., 1230 Ave. of the Americas, New York.

HAMMERS (Pneumatic)
Cleco Div., Reed Roller Bit Co., P.O. Box 2119, Houston 1, Texas.
Dallett Co., Mascher at Lippincott St., Philadelphia 33.
Dayton Pneumatic Tool Co., 8-10 Norwood Ave., Dayton, Ohio.
Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago.
Master Pneumatic Tool Co., Inc., Orwell, Ohio.
Rotor Tool Co., 17325 Euclid Ave., Cleveland 12.
*Schramm, Inc., West Chester, Pa.

HEATERS (Air)
*Despatch Oven Co., 619 S.E. 8th St., Minneapolis.

HEATERS (Ladle and Mold)
Macleod Co., 2232-40 Bogen St., Cincinnati 22.

HELMETS (Blasting)
*Alloy Metal Abrasive Co., 311 W. Huron St., Ann Arbor, Mich.
American Optical Co., 14 Mechanic St., Southbridge, Mass.
Mine Safety Appliances Co., Braddock, Thomas & Meade Sts., Pittsburgh 8.
*Pangborn Corp., Hagerstown, Md.
Pulmosan Safety Equipment Corp., 176 Johnson St., Brooklyn 1, N.Y.
Safety Clothing & Equipment Co., 7016 Euclid Ave., Cleveland.
W. W. Sly Mfg. Co., 4700 Train Ave., Cleveland.

HELMETS (Welding)
American Optical Co., 14 Mechanic St., Southbridge, Mass.
Mine Safety Appliances Co., Braddock, Thomas & Meade Sts., Pittsburgh 8.
Pulmosan Safety Equipment Corp., 176 Johnson St., Brooklyn 1, N.Y.
Safety Clothing & Equipment Co., 7016 Euclid Ave., Cleveland.

HOISTS (Chain or Electric)
Chisholm-Moore Hoist Corp., Tonawanda, N.Y.
Harnischfeger Corp., 4400 W. National Ave., Milwaukee 14.
*Whiting Corp., 15628 Lathrop Ave., Harvey, Ill.

HOISTS (Mobile)
*Hyster Co., 2902 N.E. Clackamas, Portland, Ore.
Yale & Towne Mfg. Co., 4530 Tacony St., Philadelphia 24.

HOISTS (Pneumatic)
Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago.
*Ingersoll-Rand Co., 11 Broadway, New York 4.

HOSE (Oxygen and Acetylene)
Air Reduction Sales Co., 42nd St., opposite Grand Central, New York 17.
*Manhattan Rubber Div., Raybestos-Manhattan, Inc., 61 Willett St., Passaic, N.J.
United States Rubber Co., 1230 Ave. of the Americas, New York.

HOSE (Pneumatic)
*Manhattan Rubber Div., Raybestos-Manhattan, Inc., 61 Willet St., Passaic, N.J.
A. Schraders Son, Div. of Scovill Mfg. Co., Inc., 470 Vanderbilt Ave., Brooklyn 17, N.Y.
United States Rubber Co., 1230 Ave. of the Americas, New York.

INGOTS (Aluminum Alloy)
*Alter Co., 1701 Rockingham Rd., Davenport, Ia.
*Apex Smelting Co., 2537 W. Taylor St., Chicago 12; 6700 Grant Ave., Cleveland 5.
*Bohn Aluminum & Brass Corp., Aluminum Refiners Div., 1400 Lafayette Bldg., Detroit 26.
*Christiansen Corp., 1 N. LaSalle St., Chicago 2.
Colonial Smelting & Refining Co., 2nd & Linden Sts., Columbia, Pa.
*Federated Metals Div., American Smelting & Refining Co., 120 Broadway, New York 5.
*R. Lavin & Sons, Inc., 3426 S. Kedzie Ave., Chicago 23.
*Niagara Falls Smelting & Refining Div., Continental-United Industries Co., Inc., 2204-14 Elmwood Ave., Buffalo 17, N.Y.
*North American Smelting Co., Edgemont & Tioga Sts., Philadelphia 34.
*Silverstein & Pinsof, Inc., 1720 Elston Ave., Chicago 22.
*U.S. Reduction Co., East Chicago, Ind.

INGOTS (Non-Ferrous)
*Ajax Metal Co., 46 Richmond St., Philadelphia 23.
*Bohn Aluminum & Brass Corp., Aluminum Refiners Div., 1400 Lafayette Bldg., Detroit 26.
*Bohn Aluminum & Brass Corp., Michigan Smelting & Refining Div., 1400 Lafayette Bldg., Detroit 26.
*Christiansen Corp., 1 N. LaSalle St., Chicago 2.
Colonial Smelting & Refining Co., 2nd & Linden Sts., Columbia, Pa.
*Duquesne Smelting Corp., 50 Thirty-third St., Pittsburgh 1.
*Federated Metals Div., American Smelting & Refining Co., 120 Broadway, New York 5.
Samuel Greenfield Co., Inc., 31 Stone St., Buffalo, N.Y.
*Benj. Harris & Co., Chicago Heights, Ill.
*Interstate Smelting & Refining Co., 332 S. Michigan Ave., Chicago.
*R. Lavin & Sons, Inc., 3426 S. Kedzie Ave., Chicago 23.
Nassau Smelting & Refining Co., Inc., 1 Nassau Pl., Tottenville, Staten Island 7, N.Y.
*Niagara Falls Smelting & Refining Div., Continental-United Industries Co., Inc., 2204-14 Elmwood Ave., Buffalo 17, N.Y.
*North American Smelting Co., Edgemont & Tioga Sts., Philadelphia 34.
*Silverstein & Pinsof, Inc., 1720 Elston Ave., Chicago 22.
White Bros. Smelting Corp., Richmond & Hedley Sts., Philadelphia 37.

INSULATION
Lava Crucible Co. of Pittsburgh, 627 Wabash Bldg., Pittsburgh 22.
*Quigley Co., Inc., 527 Fifth Ave., New York 17.

IRON OXIDE
*Tamms Silica Co., 228 N. LaSalle St., Chicago 1.

LABORATORY AND SCIENTIFIC EQUIPMENT
*Buehler, Ltd., 165 W. Wacker Dr., Chicago 1.
*Harry W. Dietert Co., 9330 Roselawn Ave., Detroit 4.
*Great Western Mfg. Co., 208 Choctaw, Leavenworth, Kan.
Illinois Testing Laboratories, Inc., 420 N. LaSalle St., Chicago 10.
Andrew King, Consulting Engineer, 521 Broad Acres Rd., Narberth, Pa.
*Wilkens-Anderson Co., 111 N. Canal St., Chicago 6.

LABORATORY SERVICE
*Harry W. Dietert Co., 9330 Roselawn Ave., Detroit 4.
*Charles C. Kawin Co., 431 S. Dearborn St., Chicago 5; 110 Pearl St., Buffalo 2, N.Y.
Metlab Co., 1000 E. Mermaid Lane, Philadelphia.

LADLE LININGS (Fitted)
Harbison-Walker Refractories Co., 1800 Farmers Bank Bldg., Pittsburgh 22.
Lava Crucible Co. of Pittsburgh, 627 Wabash Bldg., Pittsburgh 22.

LADLE LININGS (Plastic)
Alpha-Lux Co., Inc., 155 John St., New York 7.
G. & W. H. Corson, Inc., Plymouth Meeting, Pa.; 261 Fabian Pl., Newark, N.J.
Harbison-Walker Refractories Co., 1800 Farmers Bank Bldg., Pittsburgh 22.
Ironton Fire Brick Co., Box 124, Ironton, Ohio.
Lava Crucible Co. of Pittsburgh, 627 Wabash Bldg., Pittsburgh 22.
Pittsburgh Metals Purifying Co., 1352 Marvista St., Pittsburgh 12.

LADLES
*Industrial Equipment Co., 115 N. Ohio St., Minster, Ohio.
*Modern Equipment Co., 360 S. Spring St., Port Washington, Wis.
*Whiting Corp., 15628 Lathrop Ave., Harvey, Ill.

MAGNET CHARGERS
Ready-Power Co., 3826 Grand River Ave., Detroit 8.

MAGNETIC SEPARATORS
Dings Magnetic Separator Co., 4740 McGeogh Ave., Milwaukee.

MAGNETS
Dings Magnetic Separator Co., 4740 McGeogh Ave., Milwaukee.

MAGNETS (Lifting)
Dings Magnetic Separator Co., 4740 McGeogh Ave., Milwaukee.

MATCHPLATES
Accurate Match Plate Co., Inc., 1847 W. Carroll Ave., Chicago 12.
Carlson Pattern Shop, Inc., 616 Berkshire Ave., Springfield 9, Mass.
*City Pattern Foundry & Machine Co., 1161 Harper Ave., Detroit 11.
*Grundy & Svenson, S.W. Cor. Front & Olney Aves., Philadelphia 20.
*Pennsylvania Chaplet Co., Ashland & E. Lewis Sts., Philadelphia 24.
*Plaster Process Castings Co., 6924 Carnegie Ave., Cleveland 3.
*Plastic Corp. of Chicago, 2444 S. Central Ave., Chicago 50.
Pressure Match Plate Co., Inc., 1013-15 N. Front St., Philadelphia 23.
*Scientific Cast Products Corp., 1390 E. 40th St., Cleveland; 2520 W. Lake St., Chicago.

MAULS
*General Handle Co., Rice Lake, Wis.

METALLOGRAPHIC EQUIPMENT
*Buehler, Ltd., 165 W. Wacker Dr., Chicago 1.

METERS (Air Velocity)
Illinois Testing Laboratories, Inc., 420 N. LaSalle St., Chicago 10.

MILLING CUTTERS
Severance Tool Industries Inc., P.O. Box 850, Saginaw, Mich.

MOLD CONVEYORS
C. O. Bartlett & Snow Co., 6200 Harvard Ave., Cleveland 5.
*Chain Belt Co., 1600 W. Bruce St., Milwaukee 4.

*Engineering Service, Inc., 610 W. Michigan St., Milwaukee 3.
*Jeffrey Mfg. Co., 977 N. Fourth St., Columbus 16, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago 9.
*Logan Co., 201 Cabel St., Louisville 6, Ky.
*National Engineering Co., 549 W. Washington Blvd., Chicago 6.
Newaygo Engineering Co., Newaygo, Mich.
Palmer-Bee Co., Detroit 12.
*W. G. Reichert Engineering Co., 1060 Broad St., Newark 2, N.J.
*Sklenar Furnace & Mfg. Co., 38 Memorial Dr., Cambridge, Mass.
Standard Sand & Machine Co., 549 W. Washington Blvd., Chicago 6.
*Jervis B. Webb Co., 8951 Alpine Ave., Detroit 4.

MOLD DRIVING TORCHES
*Sklenar Furnace & Mfg. Co., 38 Memorial Dr., Cambridge, Mass.

MOLDING MACHINES
*Adams Co., Fourth Street Extension, Dubuque, Ia.
Arcade Mfg. Div., Rockwell Mfg. Co., 600 E. Vienna Ave., Milwaukee 1.
*Beardsley & Piper Co., Div. Pettibone Mulliken Corp., 2424 N. Cicero Ave., Chicago 39.
Champion Foundry & Machine Co., 1316 W. 21st St., Chicago 8.
Crescent Machine Div., Rockwell Mfg. Co., 600 E. Vienna Ave., Milwaukee 1.
Delta Mfg. Div., Rockwell Mfg. Co., 600 E. Vienna Ave., Milwaukee 1.
Fellows Corp., 1012 N. Third St., Milwaukee 3.
Herman Pneumatic Machine Co., 1806 Union Bank Bldg., Pittsburgh 22.
Hill & Griffith Co., Cincinnati 4; Birmingham 1; Chicago 50.
International Molding Machine Co., P.O. Box 310, LaGrange Park, Ill.
*Johnston & Jennings Co., 877 Addison Rd., Cleveland.
*Milwaukee Foundry Equipment Co., 3238 W. Pierce St., Milwaukee.
Wm. H. Nicholls Co., Inc., 126th St., & 91st Ave., Richmond Hill 18, N.Y.
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland 14.
*Sklenar Furnace & Mfg. Co., 38 Memorial Dr., Cambridge, Mass.
SPO, Inc., 7500 Grand Division Ave., Cleveland.
*Tabor Mfg. Co., 6225 Tacony St., Philadelphia 35.

MOLD OVENS AND DRYERS
*Foundry Equipment Co., 1831 Columbus Rd., Cleveland 13.
*Kirk & Blum Mfg. Co., 2876 Spring Grove Ave., Cincinnati.
*Young Brothers Co., 6500 Mack Ave., Detroit 7.

MONORAIL AND TRAMRAIL SYSTEMS
Chisholm-Moore Hoist Corp., Tonawanda, N.Y.
*W. G. Reichert Engineering Co., 1060 Broad St. Newark 2, N.J.
*Jervis B. Webb Co., 8951 Alpine Ave., Detroit 4.
*Whiting Corp., 15628 Lathrop Ave., Harvey, Ill.

NICKEL AND NICKEL ALLOYS
*International Nickel Co., 67 Wall St., New York 5.

OILS (Lubricating)
*Delta Oil Products Co., 6263 N. Cedarburg Rd., Milwaukee 9.
*E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33.
*Penola Inc., 221 N. LaSalle St., Chicago 1.
Smith Oil & Refining Co., Rockford, Ill.
United Oil Mfg. Co., 1429-31 Walnut St., Erie, Pa.

OVENS (Annealing and Heat Treating)
*Despatch Oven Co., 619 S.E. 8th St., Minneapolis.
*Foundry Equipment Co., 1831 Columbus Rd., Cleveland 13.
*Kirk & Blum Mfg. Co., 2876 Spring Grove Ave., Cincinnati.
*Whiting Corp., 15628 Lathrop Ave., Harvey, Ill.
*Young Brothers Co., 6500 Mack Ave., Detroit 7.

OXYGEN
Air Reduction Sales Co., 42nd St., opposite Grand Central, New York 17.
Linde Air Products Co., 30 E. 42nd St., New York 17.

PATTERN COATINGS AND FINISHES
*Kindt-Collins Co., 12651 Elmwood Ave., Cleveland 11.
*McDougall-Butler Co., Inc., 6 Evans St., Buffalo 5.
P.M.S. Co., 1071 Power Ave., Cleveland 14.
Wellman Products Co., 1444 E. 49th St., Cleveland 3.

PATTERN COMPOUND
*Tamms Silica Co., 228 N. LaSalle St., Chicago 1.

PATTERN LUMBER
*Dougherty Lumber Co., 4300 E. 68th St., Cleveland.
*Kindt-Collins Co., 12651 Elmwood Ave., Cleveland 11.

PATTERN PLATES
Carlson Pattern Shop, Inc., 616 Berkshire Ave., Springfield 9, Mass.
Combined Supply & Equipment Co., Inc., 215 Chandler St., Buffalo, N.Y.
*Dougherty Lumber Co., 4300 E. 68th St., Cleveland.
Freeman Supply Co., 1152 E. Broadway, Toledo 5.
*Kindt-Collins Co., 12651 Elmwood Ave., Cleveland 11.
P.M.S. Co., 1071 Power Ave., Cleveland 14.
*Scientific Cast Products Corp., 1390 E. 40th St., Cleveland; 2520 W. Lake St., Chicago.
Wellman Products Co., 1444 E. 49th St., Cleveland 3.

PATTERN PLATES (Plastic)
*Plastic Corp. of Chicago, 2444 S. Central Ave., Chicago 50.

PATTERNS
Carlson Pattern Shop, Inc., 616 Berkshire Ave., Springfield 9, Mass.
*City Pattern Foundry & Machine Co., 1161 Harper Ave., Detroit 11.
*Grundy & Svenson, S.W. Cor. Front & Olney Aves., Philadelphia 20.

PATTERNS (Plastic)
*Plastic Corp. of Chicago, 2444 S. Central Ave., Chicago 50.

PATTERN SHOP EQUIPMENT AND SUPPLIES
Combined Supply & Equipment Co., Inc., 215 Chandler St., Buffalo, N.Y.
DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
Freeman Supply Co., 1152 E. Broadway, Toledo 5.
*Kindt-Collins Co., 12651 Elmwood Ave., Cleveland 11.
*Oliver Machinery Co., 1025 Clancy Ave., Grand Rapids 2, Mich.
P.M.S. Co., 1071 Power Ave., Cleveland 14.
Severance Tool Industries, Inc., P.O. Box 850, Saginaw, Mich.
Wellman Products Co., 1444 E. 49th St., Cleveland 3.

PERMANENT MOLDS
Bullard Gage Co., 17168 Redford Ave., Detroit 19.

PHOTOGRAPHIC MATERIALS (Metallography)
*Buehler, Ltd., 165 W. Wacker Dr., Chicago 1.

PIG IRON
Debevoise-Anderson Co., Inc., New York; Philadelphia; Boston; New Haven, Conn.
*Hickman, Williams & Co., Cleveland; Chicago; Cincinnati; St. Louis; Pittsburgh; Philadelphia; New York; Detroit.
*Jackson Iron & Steel Co., Jackson, Ohio.
*Keokuk Electro-Metals Co., Keokuk, Ia.
Tennessee Products & Chemical Corp., American National Bank Bldg., Nashville 3, Tenn.
*Tonawanda Iron Corp., North Tonawanda, N.Y.

PIG IRON (Alloy)
Debevoise-Anderson Co., Inc., New York; Philadelphia; Boston; New Haven, Conn.
*Jackson Iron & Steel Co., Jackson, Ohio.

PLASTER
*Tamms Silica Co., 228 N. LaSalle St., Chicago 1.
*United States Gypsum Co., 300 W. Adams St., Chicago 6.

PNEUMATIC TOOLS
Buckeye Tools Corp., 29 W. Apple St., Dayton, Ohio.
Cleco Div., Reed Roller Bit Co., P.O. Box 2119, Houston 1, Texas.
Dallett Co., Mascher at Lippincott St., Philadelphia 33.
Davey Compressor Co., Maple & Walnut Sts., Kent, Ohio.
Dayton Pneumatic Tool Co., 8-10 Norwood Ave., Dayton, Ohio.
*Ingersoll-Rand Co., 11 Broadway, New York 4.
Martin Engineering Co., 704 Rose St., Kewanee, Ill.
Master Pneumatic Tool Co., Inc., Orwell, Ohio.
Rotor Tool Co., 17325 Euclid Ave., Cleveland 12.
*Schramm, Inc., West Chester, Pa.

POROSITY EQUIPMENT AND SEALERS
*Tincher Products Co., 1715 W. Lake St., Chicago 12.

PORTABLE TOOLS (Air)
Buckeye Tools Corp., 29 W. Apple St., Dayton, Ohio.
Davey Compressor Co., Maple & Walnut Sts., Kent, Ohio.
Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago.
*Mall Tool Co., 7740 South Chicago Ave., Chicago 19.
Master Pneumatic Tool Co., Inc., Orwell, Ohio.
Rotor Tool Co., 17325 Euclid Ave., Cleveland 12.
*Schramm, Inc., West Chester, Pa.

PORTABLE TOOLS (Electric)
Buckeye Tools Corp., 29 W. Apple St., Dayton, Ohio.
Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago.
Martindale Electric Co., 1349 Hird Ave., Cleveland 7.
Syntron Co., Homer City, Pa.

POWER UNITS
Ready-Power Co., 3826 Grand River Ave., Detroit 8.

PYROMETERS (Immersion)
Foxboro Co., 36 Neponset Ave., Foxboro, Mass.
Illinois Testing Laboratories, Inc., 420 N. LaSalle St., Chicago 10.
*L. H. Marshall Co., 270 W. Lane Ave., Columbus, Ohio.
*Pyrometer Instrument Co., Inc., Portland & Delford Aves., Bergenfield, N.J.
*Tamms Silica Co., 228 N. LaSalle St., Chicago 1.

PYROMETERS (Optical)
*Buehler, Ltd., 165 W. Wacker Drive, Chicago 1.
*Harry W. Dietert Co., 9330 Roselawn Ave., Detroit 4.
*Pyrometer Instrument Co., Inc., Portland & Delford Aves., Bergenfield, N.J.

RADIUM
Radium Chemical Co., Inc., 570 Lexington Ave., New York 22.

RAMMERS (Pneumatic)
Chicago Pneumatic Tool Co., 6 E. 44th St., New York 17.
Cleco Div., Reed Roller Bit Co., P.O. Box 2119, Houston 1, Texas.
Dayton Pneumatic Tool Co., 8-10 Norwood Ave., Dayton, Ohio.
Master Pneumatic Tool Co., Inc., Orwell, Ohio.
Rotor Tool Co., 17325 Euclid Ave., Cleveland 12.

REFRACTORIES
Alpha-Lux Co., Inc., 155 John St., New York 7.
American Crucible Co., North Haven, Conn.
G. & W. H. Corson, Inc., Plymouth Meeting, Pa.; 261 Fabian Pl., Newark, N.J.
Joseph Dixon Crucible Co., Jersey City 3, N.J.
*Eastern Clay Products, Inc., 223 Main St., Jackson, Ohio.
*Electro Refractories & Alloys Corp., 344 Delaware Ave., Buffalo, N.Y.
*Great Lakes Foundry Sand Co., 720 United Artists Bldg., Detroit 26.
*Illinois Clay Products Co., 608 S. Dearborn St., Chicago 5.
Ironton Fire Brick Co., Box 124, Ironton, Ohio.

Lava Crucible Co. of Pittsburgh, 627 Wabash Bldg., Pittsburgh 22.
National Crucible Co., Mermaid Lane & Queen St., Philadelphia 18.
National Foundry Sand Co., 2970 W. Grand Blvd., Detroit 2.
New Jersey Silica Sand Co., Box 71, Millville, N.J.
*Pennsylvania Foundry Supply & Sand Co., Ashland & E. Lewis Sts., Philadelphia 24.
George F. Pettinos, Inc., 1206 Locust St., Philadelphia 7.
*Pyro Refractories Co., Oak Hill, Ohio.
*Quigley Co., Inc., 527 Fifth Ave., New York 17.
Ross-Tacony Crucible Co., Robbins & Milnar Sts. Tacony 1, Pa.
*Frederic B. Stevens, Inc., 1800 18th St., Detroit 16.
Vesuvius Crucible Co., Swissvale, Pittsburgh 18.

RESPIRATORS

American Optical Co., 14 Mechanic St., Southbridge, Mass.
Martindale Electric Co., 1349 Hird Ave., Cleveland 7.
Mine Safety Appliances Co., Braddock, Thomas & Meade Sts., Pittsburgh 8.
Pulmosan Safety Equipment Corp., 176 Johnson St., Brooklyn 1, N.Y.
Safety Clothing & Equipment Co., 7016 Euclid Ave., Cleveland.

RIDDLES AND SCREENS

*Beardsley & Piper Co., Div. Pettibone Mulliken Corp., 2424 N. Cicero Ave., Chicago 39.
Champion Foundry & Machine Co., 1316 W. 21st St., Chicago 8.
*Great Western Mfg. Co., 208 Choctaw, Leavenworth, Kan.
*Pekay Machine & Engineering Co., 100 N. LaSalle St., Chicago 2.
*Frederic B. Stevens, Inc., 1800 18th St., Detroit 16.

SAFETY CLOTHING AND EQUIPMENT

American Optical Co., 14 Mechanic St., Southbridge, Mass.
Clersite Co., 2508 W. Van Buren St. Chicago 12.
Mine Safety Appliances Co., Braddock, Thomas & Meade Sts., Pittsburgh 8.
*Pangborn Corp., Hagerstown, Md.
Pulmosan Safety Equipment Corp., 176 John-Son St., Brooklyn 1, N.Y.
*Reece Wooden Sole Shoe Co., 2207-11th St., Columbus, Neb.
Safety Clothing & Equipment Co., 7016 Euclid Ave., Cleveland.
*Titan Safety Shoe Co., 212 Essex St., Boston 11, Mass.

SAND (Blast)

*Carpenter Brothers, Inc., 606 W. Wisconsin Ave., Milwaukee 3.
Delhi Foundry Sand Co., 6326 River Road, Cincinnati 33.
*Great Lakes Foundry Sand Co., 720 United Artists Bldg., Detroit 26.
Hougland & Hardy, Hardy Sand Co., 507 S.E. 2nd St., Evansville, Ind.
Manley Sand Co., Rockton, Ill.
National Foundry Sand Co., 2970 W. Grand Blvd., Detroit 2.
National Pulverizing Co., Millville, N.J.
New Jersey Silica Sand Co., Box 71, Millville, N.J.
*Ottawa Silica Co., Box 437, Ottawa, Ill.

SAND (Core and Mold)

Ayers Mineral Co., Zanesville, Ohio.
*Carpenter Brothers, Inc., 606 W. Wisconsin Ave., Milwaukee 3.
Central Silica Co., Zanesville, Ohio.
Delhi Foundry Sand Co., 6326 River Road, Cincinnati 33.
*Great Lakes Foundry Sand Co., 720 United Artists Bldg., Detroit 26.
*Hickman, Williams & Co., Cleveland; Chicago; Cincinnati; St. Louis; Philadelphia; New York; Detroit.
Hougland & Hardy, Hardy Sand Co., 507 S.E. 2nd St., Evansville, Ind.
Lauhoff Grain Co., Allbond Corebinder Div., Danville, Ill.
Manley Sand Co., Rockton, Ill.
Millwood Sand Co., Zanesville, Ohio.
National Foundry Sand Co., 2970 W. Grand Blvd., Detroit 2.
National Pulverizing Co., Millville, N.J.
New Jersey Silica Sand Co., Box 71, Millville, N.J.
*Ottawa Silica Co., Box 437, Ottawa, Ill.
Stoller Chemical Co., 31 N. Summit St., Akron, Ohio.
Taggart & Co., 6903 Torresdale Ave., Philadelphia 35.
Whitehead Brothers Co., 324 W. 23rd St., New York 11.

SAND BLAST EQUIPMENT

*American Wheelabrator & Equipment Corp., 630 S. Byrkit St., Mishawaka, Ind.
Macleod Co., 2232-40 Bogen St., Cincinnati 22.
*Pangborn Corp., Hagerstown, Md.
George Pfaff, Inc., 10-61 Jackson Ave., Long Island City 1, N.Y.
*Pittsburgh Crushed Steel Co., 4839 Harrison St., Pittsburgh.
W. W. Sly Mfg. Co., 4700 Train Ave., Cleveland.

SAND CONTROL AND TESTING EQUIPMENT

Alpha-Lux Co., Inc., 155 John St., New York 7.
*Buehler, Ltd., 165 W. Wacker Dr., Chicago 1.
*Harry W. Dietert Co., 9330 Roselawn Ave., Detroit 4.
*Great Western Mfg. Co., 208 Choctaw, Leavenworth, Kan.
Manley Sand Co., Rockton, Ill.

SAND HANDLING AND CONDITIONING EQUIPMENT

Allis-Chalmers Mfg. Co., 1126 S. 70th St., Milwaukee 1.
C. O. Bartlett & Snow Co., 6200 Harvard Ave., Cleveland 5.
*Beardsley & Piper Co., Div., Pettibone Mulliken Corp., 2424 N. Cicero Ave., Chicago 39.
Bell Aircraft Corp., P.O. Box 1, Buffalo 5, N.Y.
*Chain Belt Co., 1600 W. Bruce St., Milwaukee 4.
*Engineering Service, Inc., 610 W. Michigan St., Milwaukee 3.
*Great Western Mfg., Co., 208 Choctaw, Leavenworth, Kan.
Frank G. Hough Co., Libertyville, Ill.
*Jeffrey Mfg. Co., 977 N. Fourth St., Columbus 16, Ohio.
Johnson-March Corp., Drexel Bldg., Philadelphia 6.
Link-Belt Co., 300 W. Pershing Rd., Chicago 9.
Material Movement Industries, Inc., 9257 Laramie Ave., Skokie, Ill.
*Moulders' Friend, Dallas City, Ill.
*National Engineering Co., 549 W. Washington Blvd., Chicago 6.
Newaygo Engineering Co., Newaygo, Mich.
*Nichols Engineering & Research Corp., 60 Wall Tower, New York.
Palmer-Bee Co., Detroit 12.
*Pekay Machine & Engineering Co., 100 N. LaSalle St., Chicago 2.
*W. G. Reichert Engineering Co., 1060 Broad St., Newark 2, N.J.
*Royer Foundry & Machine Co., 158 Pringle St., Kingston, Pa.
Simplicity Engineering Co., Durand, Mich.
*Sklenar Furnace & Mfg. Co., 38 Memorial Dr., Cambridge, Mass.
Standard Sand & Machine Co., 549 W. Washington Blvd., Chicago 6.

SAND MIXERS

*Beardsley & Piper Co., Div. Pettibone Mulliken Corp., 2424 N. Cicero Ave., Chicago 39.
Clearfield Machine Co., Clearfield, Pa.
Freeman Supply Co., 1152 E. Broadway, Toledo 5, Ohio.
*Moulders' Friend, Dallas City, Ill.
*National Engineering Co., 549 W. Washington Blvd., Chicago 6.
Standard Sand & Machine Co., 549 W. Washington Blvd., Chicago 6.

SAND RECLAMATION

*Engineering Service, Inc., 610 W. Michigan St., Milwaukee 3.
Hydro-Blast Corp., 2550 N. Western Ave., Chicago 47.
*Nichols Engineering & Research Corp., 60 Wall Tower, New York.

SAWS (Firebrick)

*Clipper Mfg. Co., 2800 Warwick St., Kansas City 8, Mo.

SAWS (Masonry)

*Clipper Mfg. Co., 2800 Warwick St., Kansas City 8, Mo.

SAWS (Metal Cutting)

Capewell Mfg. Co., 60 Governor St., Hartford, Conn.
DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
Grob Brothers, Grafton, Wis.
Martindale Electric Co., 1349 Hird Ave., Cleveland 7.
*Oliver Machinery Co., 1025 Clancy Ave., Grand Rapids 2, Mich.

SAWS (Woodworking)

DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
*Oliver Machinery Co., 1025 Clancy Ave., Grand Rapids 2, Mich.

SEPARATORS

Dings Magnetic Separator Co., 4740 McGeogh Ave., Milwaukee.
*Kirk & Blum Mfg. Co., 2876 Spring Grove Ave., Cincinnati.
*Jas. A. Murphy & Co., 5th & Vine Sts., Hamilton, Ohio.
*Royer Foundry & Machine Co., 158 Pringle St., Kingston, Pa.

SHAKE-OUT MACHINERY

Allis-Chalmers Mfg. Co., 1126 S. 70th St., Milwaukee 1.
Cleveland Vibrator Co., 2828 Clinton Ave., W., Cleveland 13.
Herman Pneumatic Machine Co., 1806 Union Bank Bldg., Pittsburgh 22.
Link-Belt Co., 300 W. Pershing Rd., Chicago 9.
Robins Conveyors Div., Hewitt-Robins, Inc., 270 Passaic Ave., Passaic, N.J.
*Royer Foundry & Machine Co., 158 Pringle St., Kingston, Pa.
Simplicity Engineering Co., Durand, Mich.

SHOCK ABSORPTION MATERIALS

Fabreeka Products Co., 222 Summer St., Boston, Mass.

SHOT AND GRIT

*Alloy Metal Abrasive Co., 311 W. Huron St., Ann Arbor, Mich.
American Steel Abrasives Co., Sherman & East Sts., Galion, Ohio.
*American Wheelabrator & Equipment Corp., 630 S. Byrkit St., Mishawaka, Ind.
*Carpenter Brothers, Inc., 606 W. Wisconsin Ave., Milwaukee 3.
*Cleveland Metal Abrasive Co., 887 E. 67th St., Cleveland.
Delhi Foundry Sand Co., 6326 River Rd., Cincinnati 33.
Globe Steel Abrasive Co., 238 First Ave., Mansfield, Ohio.
*Great Lakes Foundry Sand Co., 720 United Artists Bldg., Detroit 26.
*Hickman, Williams & Co., Cleveland; Chicago; Cincinnati; St. Louis; Pittsburgh; Philadelphia; New York; Detroit.
*R. Lavin & Sons, Inc., 3426 S. Kedzie Ave., Chicago 23.
National Foundry Sand Co., 2970 W. Grand Blvd., Detroit 2.
*Pangborn Corp., Hagerstown, Md.
*Pennsylvania Foundry Supply & Sand Co., Ashland & E. Lewis Sts., Philadelphia 24.
George Pfaff, Inc., 10-61 Jackson Ave., Long Island City 1, N.Y.
*Pittsburgh Crushed Steel Co., 4839 Harrison St., Pittsburgh.
*Steel Shot & Grit Co., Boston, Mass.
Steel Shot Producers, Inc., Butler, Pa.
*Hyman Viener & Sons, 5300 Hatcher St., Richmond, Va.

SLINGS (Equalizing)

Chisholm-Moore Hoist Corp., Tonawanda, N.Y.
Columbus McKinnon Chain Corp., Tonawanda, N.Y.

SPECTROGRAPHIC EQUIPMENT AND SUPPLIES

*Eastman Kodak Co., 343 State St., Rochester 4, N.Y.
*National Carbon Co., Inc., 30 E. 42nd St., New York 17.

SPRAYERS

*Jas A. Murphy & Co., 5th & Vine Sts., Hamilton, Ohio.

TEMPERATURE CONTROL AND RECORDING DEVICES

Foxboro Co., 36 Neponset Ave., Foxboro, Mass.
Illinois Testing Laboratories, Inc., 420 N. LaSalle St., Chicago 10.
*L. H. Marshall Co., 270 W. Lane Ave., Columbus, Ohio.
*Pyrometer Instrument Co., Inc., Portland & Delford Aves., Bergenfield, N.J.

THERMOCOUPLES

*Harry W. Dietert Co., 9330 Roselawn Ave., Detroit 4.
Foxboro Co., 36 Neponset Ave., Foxboro, Mass.
Illinois Testing Laboratories, Inc., 420 N. LaSalle St., Chicago 10.
*L. H. Marshall Co., 270 W. Lane Ave., Columbus, Ohio.
*Pyrometer Instrument Co., Portland & Delford Aves., Bergenfield, N.J.
*Tamms Silica Co., 228 N. LaSalle St., Chicago 1.

TOTE BOXES AND BARRELS

*Kirk & Blum Mfg. Co., 2876 Spring Grove Ave., Cincinnati.

TRACTORS AND TRUCKS

Bell Aircraft Corp., P.O. Box 1, Buffalo 5, N.Y.

TUMBLING BARRELS (Dry)

N. Ransohoff, Inc., 16 E. 72nd St., Cincinnati 16.
W. W. Sly Mfg. Co., 4700 Train Ave., Cleveland.
*Whiting Corp., 15628 Lathrop Ave., Harvey, Ill.

TUMBLING BARRELS (Wet)

N. Ransohoff, Inc., 16 E. 72nd St., Cincinnati 16.
W. W. Sly Mfg. Co., 4700 Train Ave., Cleveland.
*Whiting Corp., 15628 Lathrop Ave., Harvey, Ill.

VACUUM CLEANING EQUIPMENT

Invincible Vacuum Cleaner Mfg. Co., Inc., 4626-28 Baltimore Ave., Philadelphia 43.
Roots-Connersville Blower Corp., 900 W. Mount St., Connersville, Ind.
Spencer Turbine Co., 486 New Park Ave., Hartford 6, Conn.
*U.S. Hoffman Machinery Corp., 99 Fourth Ave., New York 3.

VENTILATING SYSTEMS

*American Wheelabrator & Equipment Corp., 630 S. Byrkit St., Mishawaka, Ind.
C. O. Bartlett & Snow Co., 6200 Harvard Ave., Cleveland 5.
*Kirk & Blum Mfg. Co., 2876 Spring Grove Ave., Cincinnati.
*Pangborn Corp., Hagerstown, Md.
Powermatic Ventilator Co., 4019 Prospect Ave., Cleveland 3.
*W. G. Reichert Engineering Co., 1060 Broad St., Newark 2, N.J.
H. H. Robertson Co., 2400 Farmers Bank Bldg., Pittsburgh 22.
*Claude B. Schneible Co., 2827 - 25th St., Detroit.

VIBRATORS

Arcade Mfg. Div., Rockwell Mfg. Co., 600 E. Vienna Ave., Milwaukee 1.
Cleveland Vibrator Co., 2828 Clinton Ave., W., Cleveland 13.
Crescent Machine Div., Rockwell Mfg. Co., 600 E. Vienna Ave., Milwaukee 1.
Dallett Co., Mascher at Lippincott St., Philadelphia 33.
Delta Mfg. Div., Rockwell Mfg. Co., 600 E. Vienna Ave., Milwaukee 1.
Herman Pneumatic Machine Co., 1806 Union Bank Bldg., Pittsburgh 22.
*Johnston & Jennings Co., 877 Addison Rd., Cleveland.
Martin Engineering Co., 704 Rose St., Kewanee, Ill.
SPO, Inc., 7500 Grand Division Ave., Cleveland.
Syntron Co., Homer City, Pa.

WASH ROOM EQUIPMENT

Bradley Washfountain Co., 2203 W. Michigan St., Milwaukee.
*Onox, Inc., 121 Second St., San Francisco 5.

WAX (Vent)

P.M.S. Co., 1071 Power Ave., Cleveland 14.
United Compound Co., 328 S. Park Ave., Buffalo, N.Y.
Wellman Products Co., 1444 E. 49th St., Cleveland 3.

WELDING AND CUTTING EQUIPMENT

Air Reduction Sales Co., 42nd St., opposite Grand Central, New York 17.
Arcos Corp., 1515 Locust St., Philadelphia 2.
DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.
Harnischfeger Corp., 4400 W. National Ave., Milwaukee 14.
Linde Air Products Co., 30 E. 42nd St., New York 17.

WELDING RODS

Arcos Corp., 1515 Locust St., Philadelphia 2.
*International Nickel Co., Inc., 67 Wall St., New York 5.
Linde Air Products Co., 30 E. 42nd St., New York 17.

WHEELBARROWS

Bell Aircraft Corp., P.O. Box 1, Buffalo 5, N.Y.
*Sterling Wheelbarrow Co., 7036 W. Walker St., Milwaukee 14.

WOODWORKING MACHINERY

Freeman Supply Co., 1152 E. Broadway, Toledo 5, Ohio.
*Kindt-Collins Co., 12651 Elmwood Ave., Cleveland 11.
*Oliver Machinery Co., 1025 Clancy Ave., Grand Rapids 2, Mich.
P.M.S. Co., 1071 Power Ave., Cleveland 14.

X-RAY EQUIPMENT AND SUPPLIES

*Eastman Kodak Co., 343 State St., Rochester 4, N.Y.
*General Electric X-Ray Corp., 4855 W. McGeogh Ave., Milwaukee 14.